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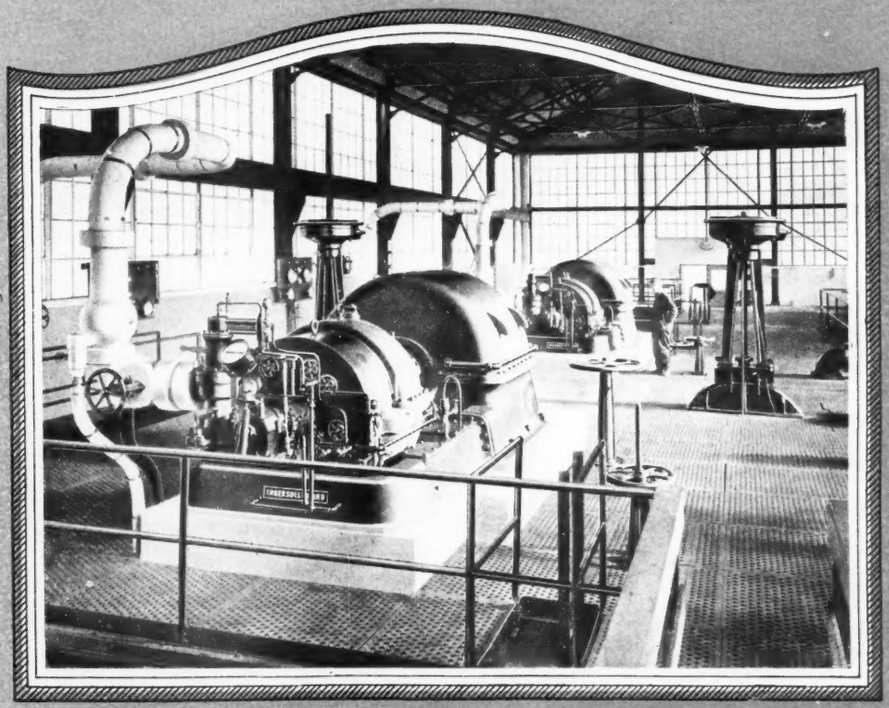

TURBO BLOWERS IN A WESTERN GAS PLANT WHERE THEY HANDLE 33,400 CUBIC FEET OF GAS PER MINUTE.

Compressed Air Has Many Uses in Cotton Mills
B. R. Burnham

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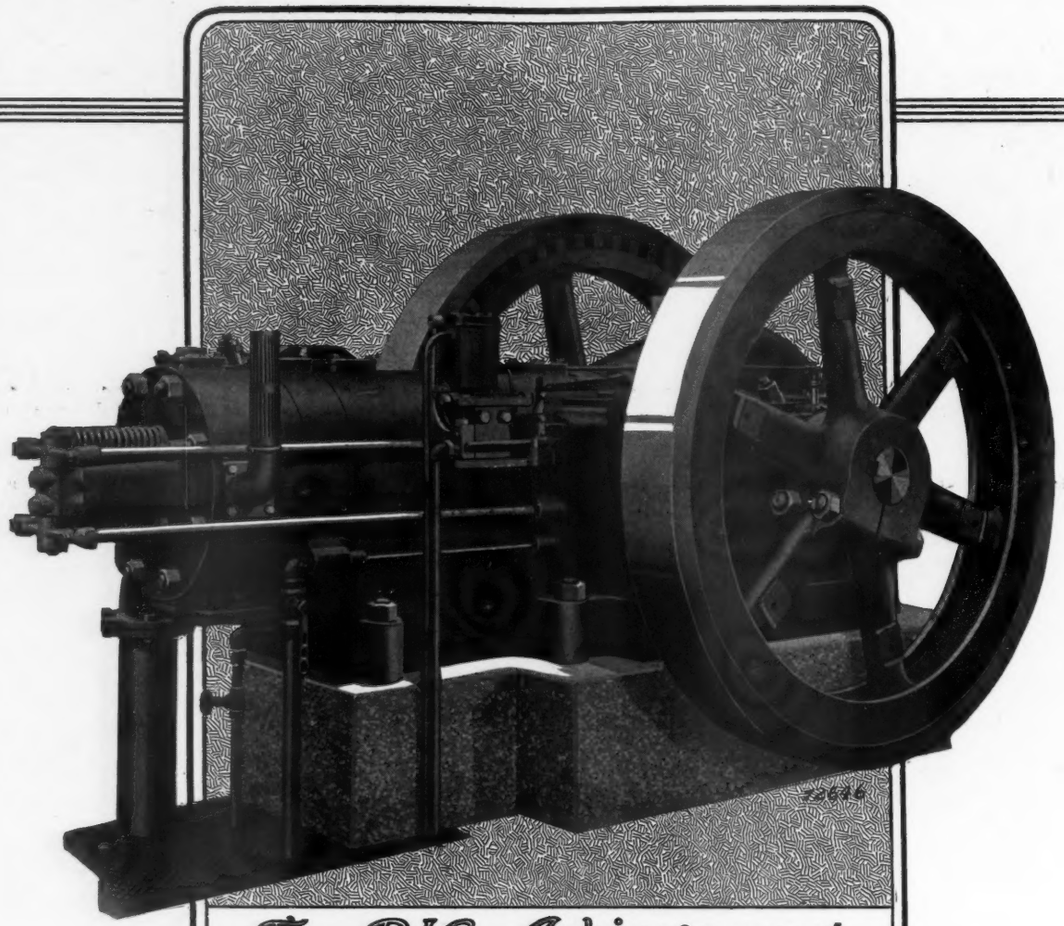

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Compressed Air Magazine

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AUGUST, 1924

Compressed Air Has Many Uses in the Cotton Mill

They Illustrate Some of the Varied Ways in Which Engineering Cunning Has Cheapened and Increased Production

By B. R. BURNHAM*

THE USE of compressed air in the cotton mill is a much argued and discussed question, not, however, of right or wrong, but merely from the standpoint of cotton-mill men. To illustrate: A few days ago, the writer heard of a cotton-mill superintendent who had given orders to have the belt taken from his compressor and rolled up. Now the author cannot understand how he gets along without compressed air, while the superintendent in the case cannot see how anyone can get along with it. Of course, compressed air can be used for cleaning in spinning and weaving in a "fine-numbered" mill; but it might prove harmful there, if not disastrous. Its use in this direction has covered a multitude of sins for the "buck-passer"; but in several instances, of which the writer has first-hand knowledge, the "sins" continued after the compressor had ceased its labors. Then, too, there is the fellow who just naturally knows better. His attitude is reflected in his mill either by the dirty walls, ceiling, hangers, pulleys, and pipes or by the price paid to do the cleaning manually.

While the services of compressed air are by no means confined to the cleaning of machinery and equipment, it was for this purpose that the compressor first found its place in the basement or the wheel room of most Southern cotton mills some fifteen years ago. Since that time its new applications in the textile industry have run electricity a very close race. A number of control jobs, once held by electricity, have now been delegated to compressed air, thereby eliminating the chance meeting of the innocent spark or short-circuit with the downy fiber—known below the Mason-Dixon line and on Wall Street as "King Cotton."

In the mills of the Whitney Manufacturing Company, for example, compressed air raises drinking water from a depth of 125 feet; runs an erstwhile electric fan; provides a means in cold weather that prevents the freezing of sprinkler lines in warehouses, thus protecting them against fire; takes care of heavy lifting where slow chain blocks were once used; does precision grinding; chips castings; drills holes, etc., and, mark you, all without fire hazard. Truly a great servant.

SUNSHINE, air, and moisture together make cotton what it is as a raw product for the textile mill. Even so, relatively few of us realize the further essential part played by air in handling the crude filaments and in working them into the fabrics of commerce.

The author has gone to some pains to make these uses of compressed air clear to the casual citizen. It will probably surprise hundreds of us to learn how numerous and helpful are the services which air thus performs at different stages in the manufacture of cotton. Here is another example of skilful adaptation.

Beginning at the bale breaker in the opening room, air is used for cleaning in every process, productive and nonproductive, including the baling of the finished goods. On the bale breaker and the vertical opener are a few inaccessible spots that do not usually come in for a great deal of cleaning. If these parts are kept free from felted fiber, sand, and dirt, the repair bill will take care of itself. The cotton picker was made to be cleaned. About 15 per cent. of the running time of the mill can be spent to good advantage in cleaning pickers; and compressed air does this work as nothing else will. The accumulation of dust and short fiber can be quickly blown from the exterior of this machine twice daily; and a hand brush can be used once weekly to remove the oil that has dripped from the older friction bearings. Before pickers were equipped with ball bearings, compressed air caused trouble by blowing both dirty and clean oil out of oil holes and bearings onto the beater blades and the screen, where it was later picked up by the stock and carried through on the finished cloth. Compressed air, however, is still on the job, while the dirt-producing bearing is gone forever.

The cotton card, the drawing frame, the slubber, the intermediate, the speeder, and the jack, all present very much the same cleaning problem as the picker, except for the amount of dirt and lint collected. But in some cases it is much better to stop the machine so as not to blow this accumulation back into the work.

The use of air for cleaning the ring spinning frame has always been the storm center of controversy among mill men. The writer is in no position to settle this matter completely, even to his own satisfaction; but, just the same, it might be well to give some of the facts and opinions for the reader's consideration. It is generally conceded that cleaning with air is good practice on very coarse "numbers," but where yarns finer than 13's or 14's are spun this method causes too many gouts—bunches of short lint caught by and twisted into the thread. However, many very successful mills are "blowing off" frames running as fine as 30's or 40's without experiencing trouble from gouts. They accomplish this by cleaning about four times daily, so that very little lint has a chance to collect. If this lint is allowed to accumulate—and where frames are cleaned manually it usually is, on account of labor cost—the air currents, caused by the rapid rotation of spindles and cylinder, draw bunches of this lint toward the thread and it is twisted in. Besides, why clean frames by hand only once daily when they can be cleaned four times by air at less effort and expense?

*Superintendent, Whitney Manufacturing Company's cotton mills.

The cleaning of the spooler is a much simpler matter inasmuch as it is, in a sense, a nonproductive machine and the blowing off can, therefore, be performed while it is stopped. Of course, bad work can be done here, too, if the air is not applied intelligently. In the accompanying photograph of a spooler there may be seen a home-made strap padlocked around a key valve. This safeguard positively prevents tampering and the unauthorized use of the air by incompetent persons. Below the valve is a quick-hitch coupling which can be connected by a twist of the wrist. This coupling is a real labor saver.

The cleaning of drop-wires on a warper has come in for a great deal of study, as it is important that they be kept free from lint, etc. Should sufficient lint collect in these drop-wires they fail to drop and to stop a warper when a warp thread or end breaks—thus leaving the section beam one thread short. By means of a new process, these ends are counted by fine steel fingers which, figuratively speaking, keep repeating to the warper-tender, "Be sure your sins will find you out." To obviate this breakage, and for the sake of neatness and order, innumerable devices—ranging from a crude cardboard fan, which pounded the knuckles of the tender, to an expensive, traveling electric fan—have been used with more or less success, generally speaking, less. One of our pictures of a warper shows the operator holding a short piece of ½-inch hose, leading from an air line above, with a plain push-button gun attached to the lower end. The warper-tender gladly runs this across the drop-wires every time his machine is stopped and thus blows the lint—which is not allowed to accumulate—straight onto the floor at exactly the right velocity to cause it to "stay put." None of it "carries over" on the thread, and none of it goes into the next warper to cause trouble.

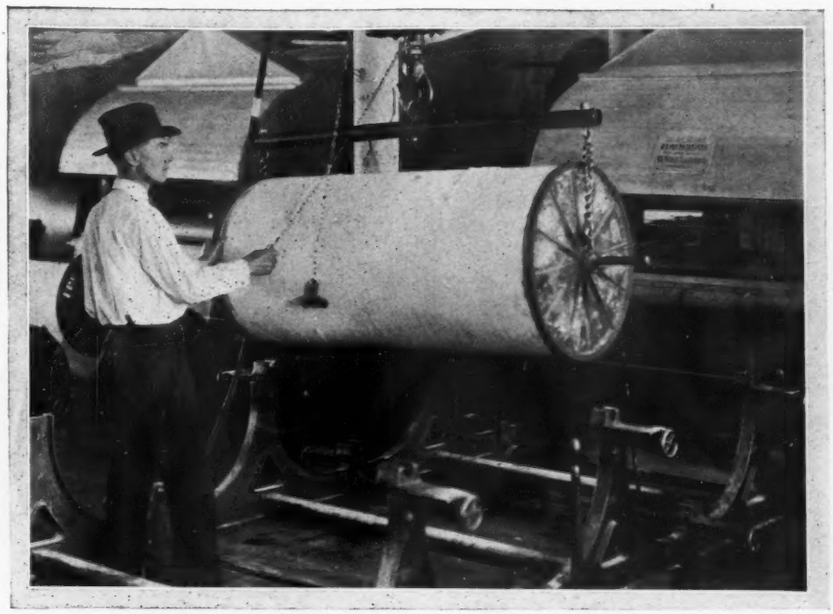
Looms have been and are being cleaned without the use of air; but this is not the cheapest and the most efficient way to do it. A careful, well-instructed blow-off man, good air appliances, and dry air at a pressure of 70 pounds —some say 40—can save a mill the power cost as well as the maintenance charge of a compressor. In the loom room extreme care must be exercised lest lint and "size," shed from the warp, be blown back into the warp or the harness, causing the ends to mat and to break out. Here, too, oil can very easily be blown from the bearings onto the warp or the woven cloth. This means trouble: ask any mill man. The under part of a loom is, necessarily, the dirtiest collection of iron and steel in the average cotton mill, as oil, size, and lint combine to defy respectability. However, periodical cleaning with air while the loom is running and a thorough "going over" when the warp is out seem to satisfy the otherwise particular mill man.

Air, like cotton fiber, must be handled properly at each stage, or the result will not give satisfaction. Failure to recognize this essential fact has been responsible for the shutting down of many cotton-mill compressors. It has long been well known that while air is being compressed the friction between the molecules generates heat. This necessitates the use of an aftercooler in which the air is passed over cold-water coils to induce the precipitation of its moisture content. This moisture is then trapped and discharged through a waste drain. Passing from the aftercooler, the air enters a receiver or storage tank. This tank maintains a considerable volume of air at the desired pressure; prevents fluctuation in pressure; and

Fig. 1—Compressed air effectively used in cleaning the ring spinning frame. This clears away lint and prevents the forming of thick places or "gouts" in the thread. Fig. 2—A stream of compressed air, in the hands of a capable operative, is an excellent medium for cleaning a spooler. Note the strap around the key valve in the air line, to the left, to prevent the unauthorized use of the air. Fig. 3—Clean drop-wires are essential to the proper working of a warper. The operator is cleaning the wires, while the machine is running, by means of a jet of compressed air which is brought into play by pressing a button just above the nozzle in his hand.

makes it practicable to store a reserve to be drawn upon as needed. Such a compressor-plant layout supplies dry air to the nozzles and to the controls. Air that is not dry and free from oil is a never-ending source of annoyance in a cotton mill, as it will leave a deposit on the machinery and make it almost impossible to get rid of the short fiber or lint. Oil in the air line is usually caused by the over-heating of the compressor on account of faulty circulation through the water jacket, or by the use of insufficient lubricating oil.

The cotton mill under consideration is equipped with a 12x10-inch horizontal compressor rated at about 325 cubic feet of free air per minute when running at a speed of 250 R.P.M. The unit is belt connected to a 50-H.P. motor; and at a pressure of 75 pounds the power cost is, roughly, $2,000 per year. Some operators claim that over 40 pounds pressure for the cleaning of machinery is a waste of power. Of course, if air at a pressure of 40 pounds will get results, why use more? High-pressure air can do a lot of damage when applied by an untrained man; but, on the other hand, it can do a lot of extra-good cleaning when manipulated by a careful man. So much for the never-ending job of keeping the intricate machinery in a cotton mill fit for its work.

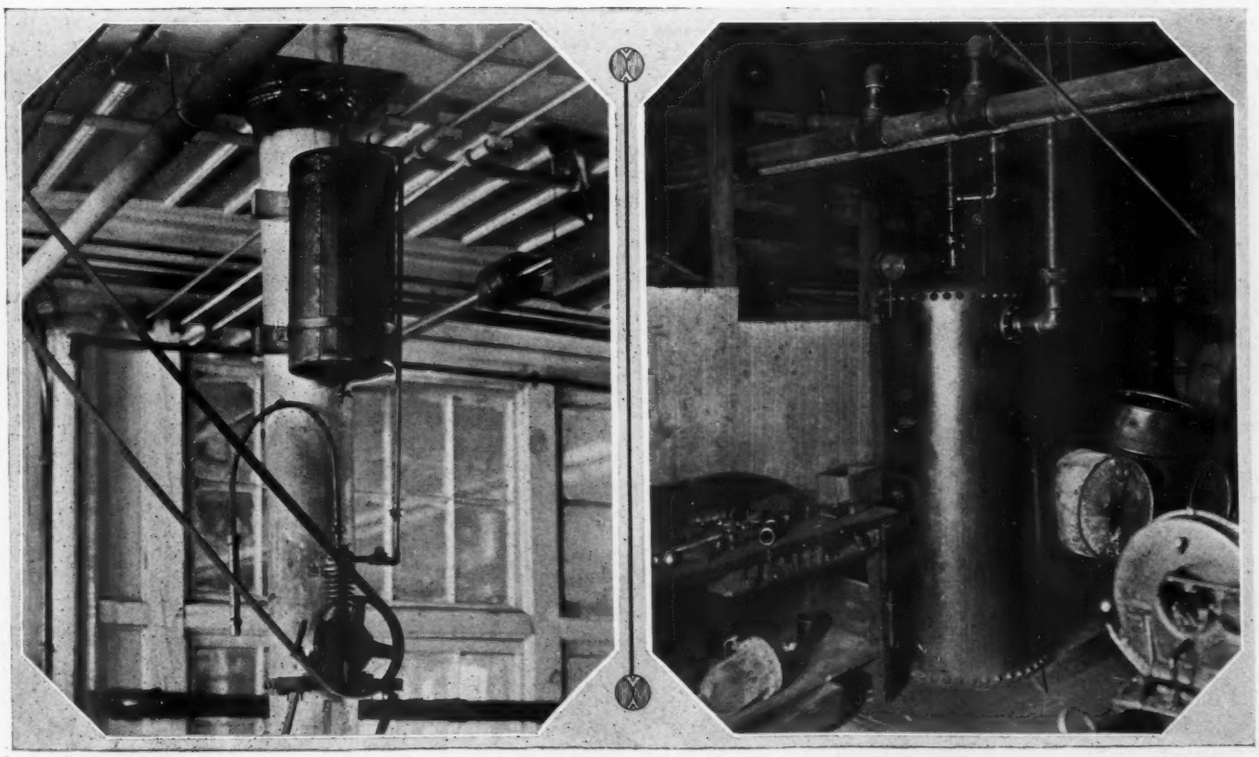


Portable air hoists have demonstrated their handiness and their usefulness in the cotton mill. The hoist in the picture serves to handle section beams weighing as much as 500 pounds.

For the handling of section beams, weighing up to 500 pounds, a small, portable air hoist has been found very serviceable. The hoist illustrated travels on a regular factory-type trolley track. It serves four slashers and the reserve section-beam storage space; and it has operated continuously for six years without getting out of order—in other words, in all that time it has needed no repairs or adjustment.

The method of raising water from deep wells by compressed air is one that gives little if any trouble—in short, can be almost forgotten once the installation is made. In the plant of the Whitney Manufacturing Company, the regular line pressure of 75 pounds is carried nearly to the bottom of the well—that is, considerably below the water level. A ½-inch air line is turned up into a 2-inch pipe, and at this point there is attached a home-made jet. The whole arrangement is absolutely free from valves and like weaknesses; and the air lift starts and stops with the compressor. The installation shown in one of the pictures has been operating for five years, and supplies a steady flow of pure Artesian water. In lifting water for service in cotton mills, air containing impurities, such as pipe scale, oil, or foul water, cannot be tolerated.

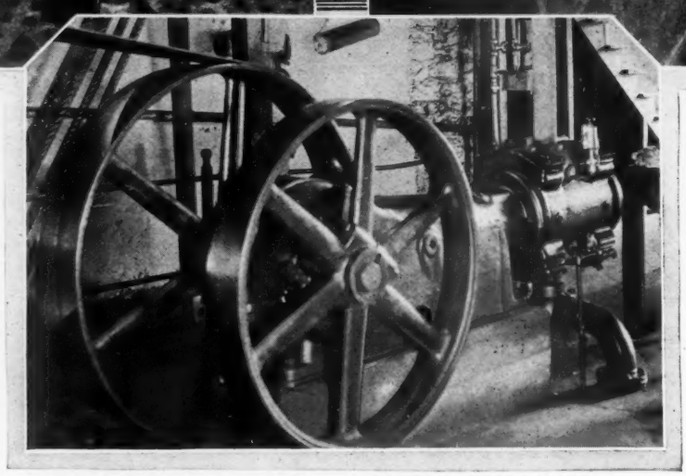
Another valuable service rendered by compressed air is in connection with the dry pipe-sprinkler system which safeguards in cold weather the valuable cotton and cloth stored



Left—Small belt-driven compressor which furnishes low-pressure air for the automatic manipulation of certain valves in the steam and the air lines. The tank overhead performs the double function of an aftercooler and a receiver. Right—Typical air receiver or reservoir in which compressed air can be stored at the desired pressure and from which it can be withdrawn as needed.

This steam valve of a size kettle is controlled by compressed air through a thermostatic member. In this way the steam is turned off and on in maintaining the size at a prescribed temperature.

This air lift raises from a deep Artesian well the water supplied the Whitney mills for diversified purposes.



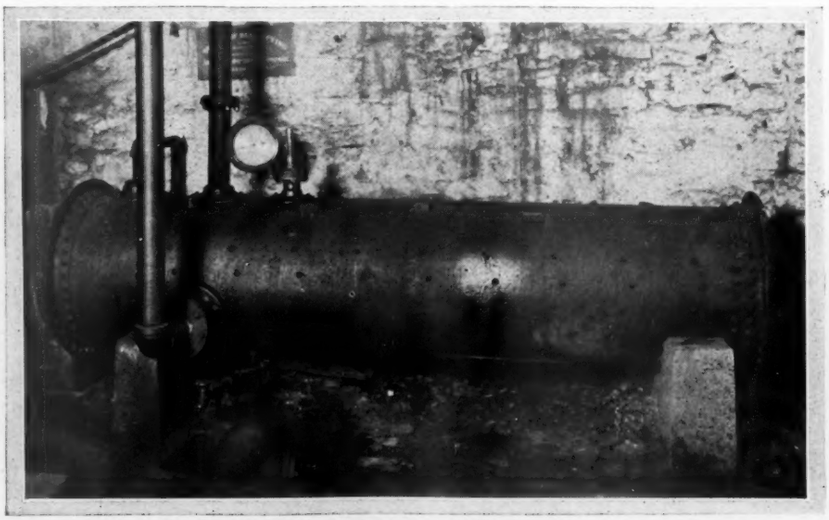
The 12x10-inch belt-driven compressor in the Whitney cotton mills which furnishes about 325 cubic feet of free air per minute at a pressure of 75 pounds.

in the warehouses. At the first sign of frost, the warehouse sprinkler lines are drained of water, and during the remainder of the cold season there is maintained in them, instead, a constant pressure of air. Should fire occur, and the heat melt the fusible plug of a sprinkler head, the air is released and the water is automatically turned into the system.

For special purposes in the cotton mill, such as the automatic manipulation of valves on steam and water lines, compressed air at a pressure of about fifteen pounds is generally employed—in fact, most manufacturers of the controls used in a cotton mill specify this pressure. Any desired pressure below the maximum carried on the high-pressure lines can be obtained by means of reducing valves, but in some cases it is more convenient to run a small compressor for this work. Such an arrangement may be seen in one of our illustrations. Because of the low pressure, a receiver will perform both the functions of an aftercooler and a receiver. Another reason for operating a small compressor for this service is that it can be driven by the same line of shafting that runs the pump which supplies water at high pressure to the humidifier lines—in other words, both the compressor and the pump start and stop together.

In textile mills, as most of us know, it is important that the prevailing atmosphere contain just the right degree of moisture. To maintain this, the Whitney cotton mills are provided with a humidifier control box which carries a regulating member that is extremely sensitive to changes in the relative humidity of the surrounding air. This member opens and closes tiny air valves which turn the air to one or the other side of a diaphragm valve on the main water line. This action, depending on conditions, automatically stops or starts the supply of water to the humidifier heads, where it is atomized and blown into the air.

Compressed air applied at a pressure of fifteen pounds to a size kettle—in which the compound used for sizing textiles is held and heated—acts in very much the same manner as it does in the case of the humidifier control. Low-pressure steam works against one side of a diaphragm and air against the other—the balance of power being held by a thermostatic member. When the temperature of the size has reached the desired point, the action of the thermostat causes the air to close the steam valve and to open it again when the temperature falls. For highest efficiency, it will be found economical to replace all such control diaphragms about once a year; and this is the only attention they usually require.



Compressed air must be dry when used for certain purposes in a cotton mill. The aftercooler here illustrated so conditions the air by chilling and precipitating the moisture content that it can meet this requirement.

The "Van Dyke" Tugs

Among the First Tugs to be Equipped with Oil-Engine-Electric Drive

THREE tugboats have recently been designed by The Atlantic Refining Company, and are now being built for them by the Staten Island Shipbuilding Company. In these boats have been embodied many novel features which will make them adaptable to every demand that can be placed upon tugboat service. In order to fully appreciate the design of these new tugs, their definite requirements must be taken into consideration.

A study has been made of the work performed by tugboats, and it was learned that in many cases 42 per cent. of the tugboat's time was spent running "light," or without a tow. It was found desirable to design a hull which would offer the minimum amount of resistance when passing through the water and which, at the same time, would be fine enough at the stern to give full, free entrance of water to the propeller, so that the maximum propeller efficiency might be obtained. The horse-power selected for these tugs was that power best suited for river and harbor towing and the docking of ships.

Having decided on the requirements, from the foregoing, the next consideration was by what means this power should be generated, and how it should be applied? A Diesel type of engine was decided upon, with electric propulsion and control. For the power generation, two stationary, 3-cylinder, 225 B.H.P. at 257 R.P.M., airless-injection, Ingersoll-Rand oil engines were selected. These engines are of American design and construction throughout, and of a type which has been in successful operation for several years.

THE engineering world was set all agog a few years ago when a collier with steam-electric drive was built for the United States Navy. Since then, the same system has been developed to propel the biggest of battle craft.

The accompanying article describes an equally significant departure in marine engineering—the construction of three tugs equipped with oil-engine-electric drive—in which the more economical oil engine supplants the steam turbine as a prime mover.

For many reasons, the oil-electric drive marks a more notable advance; and while it is admirably suited for the propulsion of towboats, which must be easily maneuvered, still the system will fill a long-felt want in many kinds of self-propelled craft.

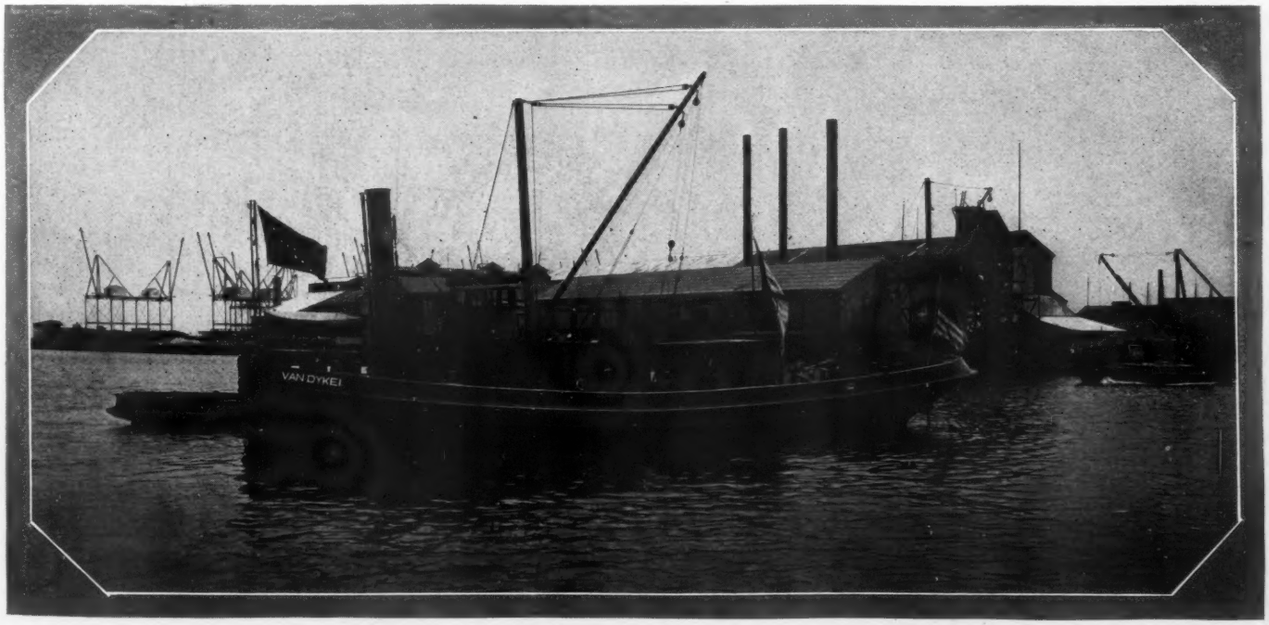
The "Van Dyke I" has successfully completed her trial trips; and one of her sister ships was launched during the past month. The performances of these vessels will be watched with great interest in nautical circles.

The electric equipment selected for this installation was that manufactured by the General Electric Company; and our company received the benefit of their knowledge and experience relative to this type of propulsion. Every detail of this electric equipment has been completely standardized to the smallest detail. Each of the two 155-KW. electric generators is directly connected to a 225-H.P. Price-Rathbun engine, and has a 26-KW. exciter on the same shaft. Each exciter is capable of all the field excitation load and auxiliary load by itself. The main propelling motor has 375 B.H.P. at 120 R.P.M.; both motors and generators will be self-ventilated and mica insulated—the finest electrical construction known!

The main control of this boat will be in the pilot house and of special design so that navigation of the boat can be controlled by one man at this point.

The auxiliary equipment is as follows: The steering gear is of the electric-hydraulic type, manufactured by the American Engineering Company. For lighting, when the engines are idle, there will be an auxiliary lighting unit consisting of one 6-H.P. bull-dog engine, manufactured by Bates & Edmonds, directly connected to a 3-KW. General Electric generator; and, in addition, a 4½x5 air compressor, for emergency starting, will be connected to this same shaft by a clutch.

The two circulating and bilge pumps, used to circulate cooling water through the engine jackets and to pump out bilge water, are of the rotary type, manufactured by the Northern Pump Company. Each pump will be capable of taking care of the circulating water for two



"Van Dyke I" just after she was launched. This type of tugboat represents the latest development in her class.

engines, and so connected that either one can be used for circulating or bilge purposes. Another pump for transferring oil from the main fuel tank to the engine-room day tanks will also be part of her equipment. To furnish air for starting the engine there will be one motor-driven Ingersoll-Rand 4½x5 air compressor.

The galley will be equipped with two "Perfection" yacht-type, kerosene, oil stoves and adjacent to the galley a mechanical, self-contained refrigerator — known as Frigidaire—of sufficient capacity to take care of all provisions. There will be one fire pump—a Cameron 2-stage centrifugal driven by a General Electric motor, capable of furnishing three or four powerful streams of water.

Summing up, the advantages combined in these tugboats are:

First—They are tugboats that will perform all classes of river and harbor work, and can safely go to sea.

Second—They can at all times be operated with a minimum crew and at maximum economy.

Third—They are efficient fire boats of generous capacity.

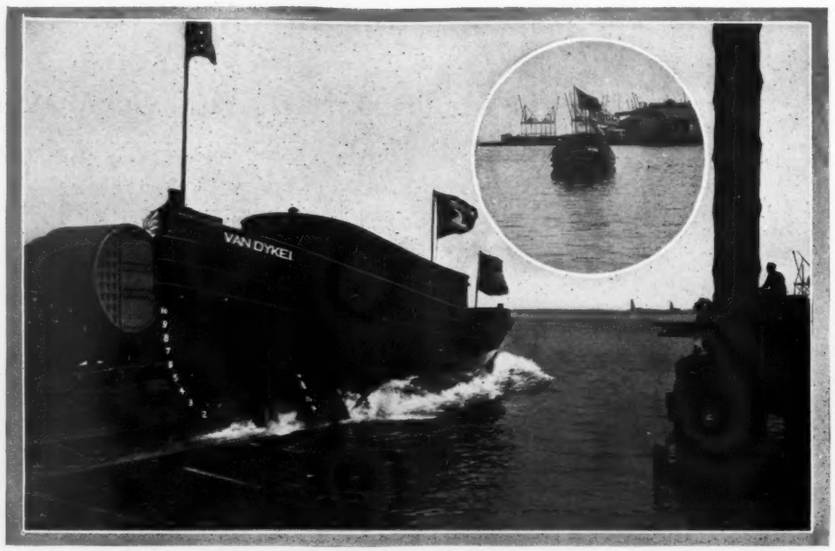
Fourth—The power arrangement of the fire pump is also adaptable for pumping out bulk barges by the installation on the barges of an electrically driven pump.

Fifth—Although these boats have two engines, the power equipment is such that one engine can do light towing, or operate the boat at suitable speed when running without a tow.

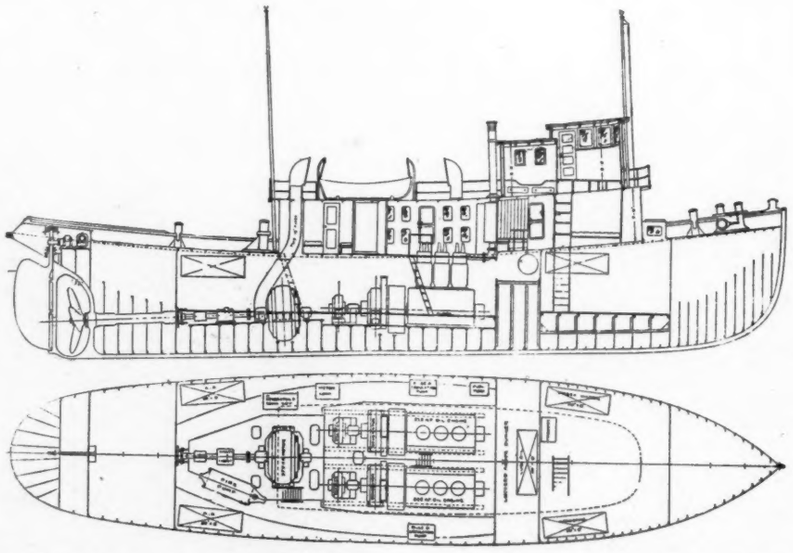
Sixth—In case of fire duty, where it is necessary to maneuver the boat at the same time, one engine can generate the pumping power, while the other engine maneuvers the boat.

The dimensions of these boats are as follows:

Length between perpendiculars, 87 feet; length over all, 97 feet; beam, 21 feet; molded depth, 11 feet 6 inches.



Just going overboard. The boat made something of a splash when she hit the water for the first time; and she has continued to create a stir by reason of her performances since.



Inboard profile and hold plan of the "Van Dyke" tugs equipped with oil-electric drive.

This article is reprinted from the *Atlantic Seal* by courtesy of the Atlantic Refining Company.

Portland cement is today the most important of all building materials, and the United States is far in the lead both in its production and in its use.

DIX RIVER DAM

THE Dix River flows through a deep and narrow gorge at a point 3½ miles above its entrance into the Kentucky River, and in this gorge there is now under construction a dam of unusual interest. This dam will be 300 feet high, and will form a lake extending back 36 miles into three counties. It will be the highest dam east of the Rocky Mountains —developing 10,000 more horse-power than the Roosevelt Dam in Arizona, which it will surpass.

In the construction of the dam there will be used 1,600,000 cubic yards of material, including 160,000 barrels of cement. The structure will be 70 feet thick at the base and 24 feet at the top, and reach from wall to wall of the gorge a distance of 760 feet. On one side there will be a channel through which flood waters may escape to the river beneath, and on the other side—90 feet below the top, the water will be led through four great penstocks to the power house at the foot.

CEMENT GUN USED TO SPREAD ROCK DUST

RECENT experiments have been made in a New Mexico colliery looking to the employment of the cement gun for the spreading of rock dust. Instead of a batch of concrete, the apparatus, stationed at the intake end of the main entry, ejects a stream of fine, dry shale dust into a strong ventilating current.

The tests indicate that the shale dust was discharged at the rate of a ton per hour. The velocity of the air current in one test was 800 to 1,000 linear feet per minute at the intake, and about 400 linear feet 6,000 feet distant. The dust cloud at this point was dense for a period of 25 minutes after the cement gun was started; and definite evidence of dust settlement was found as far as 9,000 feet from the gun. To get an even distribution of dust through an entry, it would be necessary to shift the dusting machine from time to time; and to obtain a deposit of, say, 4 pounds per linear foot in an entry 98 square feet in cross section and 6,000 feet long it would be necessary to distribute a ton of dust per hour for twelve hours.

The Tirso hydro-electric project, which has involved the construction of an artificial lake and dam, has just been completed in Sardinia. Six more plants, the second of which is already underway, are to be built on various parts of the island within the next five years.

Skagit River Hydro-Electric Development

Project Now Delivers 55,000 Horse-Power to Seattle and May Ultimately Produce More Than Half a Million Horse-Power for the Whole of Western Washington

By S. G. ROBERTS

SEATTLE is setting an example in municipal enterprise which will be watched with keen interest by the governments of many other cities both in the United States and abroad. During the present month, unless something untoward interferes, Seattle will draw current for its electric lights from a power plant situated on the Skagit River at a point 100 miles away. Not only that, but this energy from falling waters will be made available to householders and to industrial concerns located within the city's gates.

This achievement is the present climax of an imposing project which has for its goal the ultimate development of 555,000 H.P., or an annual output of 2,000,000,000 kilowatt-hours. Before taking up the details of this ambitious undertaking, this example of municipal engineering and ownership, let us refresh our minds regarding Seattle as a business center so that we can more accurately evaluate her progress.

Seattle was incorporated as a municipality in 1869, and the census of the year following revealed a population of 1,107 persons. Today, her population is substantially 345,000, and her growth between 1910 and 1920 showed an increment of virtually 33 per cent. Five years ago, Seattle ranked 26th among our manufacturing cities, and the value of her products in 1919 amounted to $274,431,000. There were then more than 1,200 manufacturing establishments in the community which, by the way, has an area of 89.5 square miles. As most of us are aware, Seattle is the foremost seaport of the State of Washington, and besides shipping commodities to all parts of the world she sends a great tonnage of manufactures, lumber, minerals, farm products, canned fish, etc., to the east coast of the United States by way of the Panama Canal.

Left—In Newhalem Tunnel, where a Little Tugger hoist was used to haul mucking cars. Right—Blacksmith shop at Newhalem equipped with "Leyner" sharpener, pedestal bit punch, and pedestal grinder, which kept the drill steels fit for their work in driving the tunnel. Bottom—Sawmill at Newhalem camp capable of turning out 25,000 board feet of lumber daily.

The Department of Public Works of the City of Seattle has gone fairly far afield to utilize the power resources of the state's "white coal;" but, from an electrical point of view, transmission lines 100 miles long do not entail really serious electric losses. Indeed, this loss will be well below 10 per cent. at the farthest point of delivery; and the municipal authorities are satisfied that cheaper current than is now possible with oil-fired or coal-burning plants will stimulate the demand and furnish a ready market for the entire output of the new installation.

The Cascade Mountains cross the State of Washington from north to south, dividing it into two separate sections with more or less differing industrial activities. Several of the dominating peaks rise to great heights and carry caps of snow well-nigh the year round. It is largely through the melting of the snow on the towering slopes of the range and to the rain precipitated from the moisture-laden clouds blown eastward from the Pacific that there are fairly long periods of flood waters descending west-

ward toward the sea. Circumstances of this character were found to be especially favorable, as far as Seattle is concerned, in the upper valley of the Skagit River.

This stream has a length of 150 miles, and its drainage area embraces a region of 3,000 square miles. The project, in its entirety, will be located upon the uppermost third of the river which is fed by water draining into it from an area of 1,200 square miles. The United States Geological Survey has recorded the stream flow over a span of twelve years; and, with an average precipitation of 70 inches annually, the mean flow of the period was found to be 4,547 cubic feet per second. The maximum flow is as high as 50,000 cubic feet per second, while the minimum observed was 800 cubic feet per second. In other words, with suitably developed reservoirs at favorable points in the river valley, it would be quite feasible to impound the flood waters so as to insure an ample reserve to run all the contemplated turbines the year through at maximum capacity. According to the engineering estimates, the execution of the whole plan would involve an outlay of $57,000,000. To date, there has been expended or obligated $9,700,000; and the purpose of this article is to tell what has been done in carrying out the work covered by this sum. In short, the intention is to describe the consummation of the first stage of the undertaking—that is, the making ready for service of the Gorge Power House, which is equipped with two turbo-generators capable of developing, with the head of water now available, a total of 55,000 H.P.

Newhalem Power House, showing the flume on the mountainside through which impulse water reaches the 3,000-H.P. waterwheel.

The scene of operations is 26 miles up the Skagit River Valley from Rockport which, in its turn, is at the easternmost end of the branch of the Great Northern Railroad tapping that territory. Preparatory to beginning work on the Gorge Power House it was necessary to build a standard-gage railway from Rockport up to that site. While this railway was under construction most of the supplies and materials were transported by tractors and pack animals. It is true that some of the heaviest machinery was conveyed up river on a scow, but this procedure was too slow and expensive to warrant general adoption.

Because of the magnitude of the task and the remoteness of the Gorge Power House site, the engineers were obliged to create locally a source of power of sufficient capacity to pro-

Photograph taken on mountainside above Gorge Power House site looking downstream toward the construction camp. This gives a good idea of the ruggedness and the majestic beauty of the valley.

Fig. 1—Sawmill which has produced all the lumber used on the project.
Fig. 2—This tumbling waterway and its rugged flanking walls give a good idea of the character of the country.
Fig. 3—Diamond drills at work making exploratory borings in the search for a suitable dam site.
Fig. 4—Here we get a conception of the rock that had to be drilled and blasted preparatory to building the construction railroad.
Fig. 5—The means employed to transfer passengers, baggage, and express matter from Rockport to the camp at Newhalem.
Fig. 6—Looking down on Newhalem camp from high up on the mountainside.

vide the motive energy needful to push the main work along at a satisfactory pace. Therefore, there was erected between Newhalem Creek and the Skagit River a hydro-electric central station in which was installed a 3,000-H.P. waterwheel connected to a 2,500-Kva. generator. The completion of this auxiliary plant involved, among other things, the sinking of a 5x5-foot shaft, 60 feet deep, and the driving therefrom of a 5x7-foot tunnel on an 8.6 per cent. grade through solid rock for a distance of 2,689 feet.

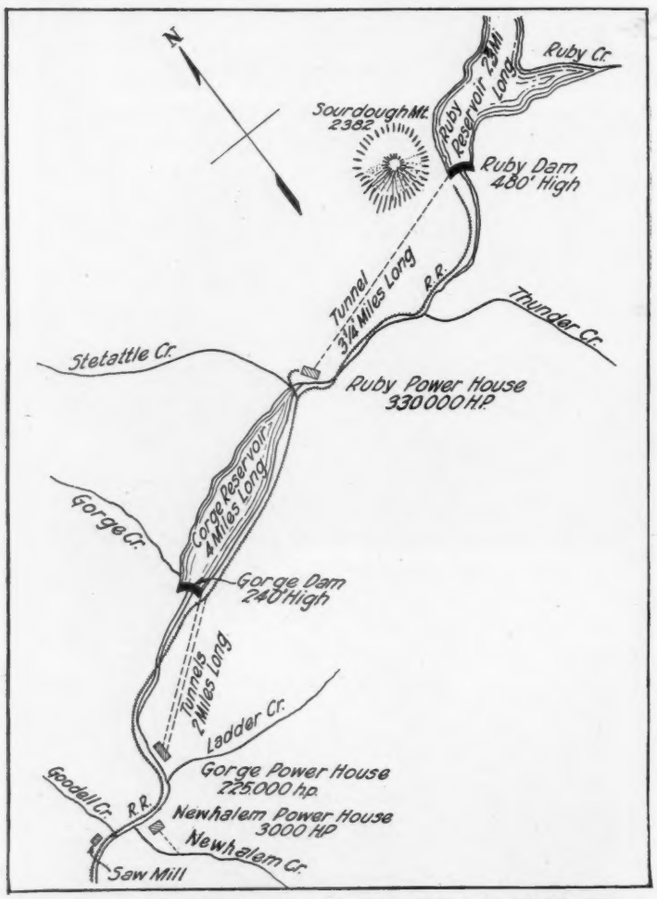
At the outlet end of this tunnel, the water from Newhalem Creek is led through electrically welded steel penstocks to the power house 905 feet away. The effective head is substantially 500 feet, which has permitted the driving of the 3,000-H.P., double-overhung, double-nozzle, impulse waterwheel at the rate of 450 revolutions a minute. The generator furnishes 3-phase, 60-cycle current at a pressure of 6,600 volts. The Newhalem Power House draws water from Newhalem Creek and discharges it into the Skagit River. The water is diverted from Newhalem Creek into the pressure tunnel by a timber-crib dam about 4 feet high—the water at the sill being at Elevation 1,016 feet. In the Newhalem Power House was also placed a 500-kilowatt motor generator set which has supplied current for operating certain of the construction facilities such, for instance, as charging the batteries of electric locomotives used for mucking in the main pressure tunnel, etc. The Newhalem development was completed in 1921.

The 5x5-foot shaft and the 5x7-foot pressure tunnel of the Newhalem development were driven with "Jackhamers" and "Leyner" drills. The rock was hard gneiss; and the drilling was carried on in three shifts—the best weekly advance being 119 feet, and the best monthly record being 471 feet. During one month, an average was maintained of a round every 4 hours and 20 minutes; and this interval covered losses of time due to all causes. Two drills on a crossbar were used at a heading; and a round consisted of twelve holes. Notwithstanding the nature of the rock encountered, the drills were in excellent shape at the end of the job. Air for the operation of the drills was furnished principally by a 14 and 14x12-inch Type FR compressor, which maintained a receiver pressure of 115 pounds. A Type Twelve portable compressor was provided as a stand-by, but it was not needed except occasionally, and then for special service.

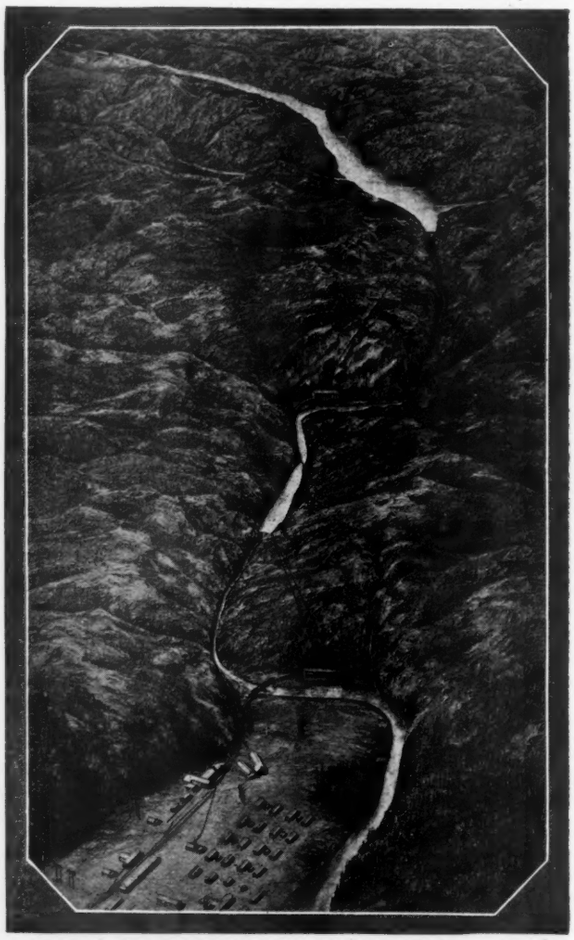
Some trouble was encountered at the early stages of the tunneling when the mucking was done by small cars which were capable of holding less than ten cubic feet of material. This trouble was overcome afterwards by the adoption of larger cars which had a capacity of 123 cubic feet.

As a further auxiliary feature, there was built and equipped on the Skagit just below Newhalem Creek a sawmill of a size capable of turning out 25,000 board feet of lumber daily; and upstream a little way was established the camp for the half thousand or more workmen required on the principal part of the undertaking. The married employees were quartered in comfortably appointed frame houses, while the unmarried men were accommodated in bunk-houses. The camp has boasted a commissary store, a hospital, a dentist's office, an assembly hall for various forms of amusement, a library, and a large mess hall. The city authorities have seen to it that the people of the camp should have every possible comfort and convenience within reason at virtually actual cost. Now let us take up the work in connection with the creation of the Gorge Power House, which is the present climax of the project and which, in the course of this month, will begin sending to far-off Seattle a block of 55,000 H.P. of electrical energy.

The Gorge plant is made up of four outstanding features—namely, a big reinforced-concrete power house situated at the downstream end of a large 2-mile pressure tunnel, a pressure tunnel, a low crib-work diversion dam, and an impounding reservoir extending northward in the river valley. The power



Map of the entire district embraced by the Skagit River project, with reservoirs, dams, tunnels, and associate power houses shown in their relative positions.



Bird's-eye view of the upper part of the Skagit River Valley extending from the proposed Ruby Reservoir to the construction camp just below Gorge Power House.

house rests upon a foundation excavated to a considerable depth out of solid rock, and is situated on the Skagit River just above the mouth of Ladder Creek. In it have been installed two vertical turbines, with a maximum rated capacity of 37,500 H.P. each when driven by water with a normal head of 375 feet. These turbines are counted upon to operate at 93 per cent. efficiency; and each is directly connected to a 30,000-Kva. generator producing 3-phase, 60-cycle current at 11,000 volts.

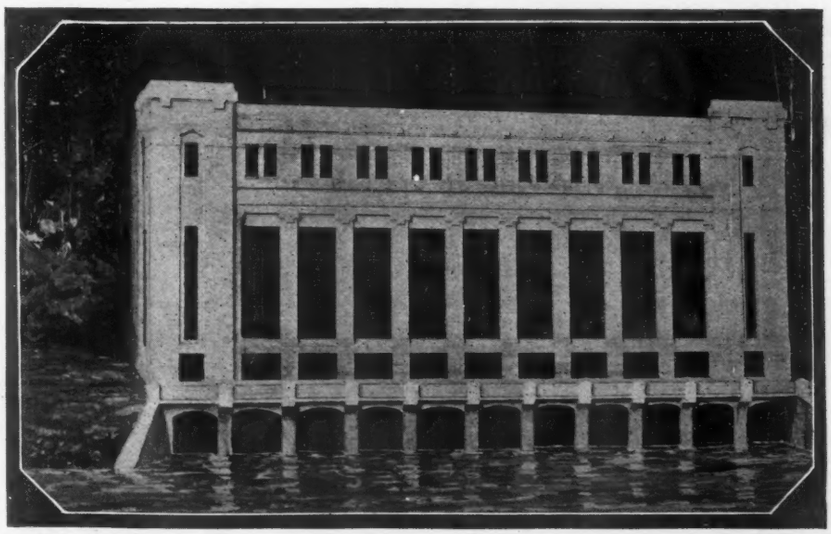
To obtain 37,500 H.P. from each turbo-generator, it will be necessary at some time in the future to supplant the crib-work diversion dam and to rear in its stead a masonry dam 240 feet high. A dam of this description would impound 6,000 acre-feet of water and create a reservoir reaching upstream for a distance of 4 miles. From side to side of the valley, the crest of the dam would be 600 feet long, and its foot would rest on solid granite at a depth of 111 feet below low water. In its construction, a matter of 185,000 cubic yards of concrete would be required. This phase of the project will not be taken in hand until the power demands of Seattle and other communities along the transmission line warrant the expenditure of an additional sum of $4,000,000.

The second stage in the development of the Gorge Power House will call for the installing of a third 37,500-H.P. unit upon the completion of the proposed 240-foot dam. Ultimately, if this power house is utilized to its designed capacity, it will contain six of these units and have a total output of 225,000 H. P. Then, operating water will be delivered to it through two pressure tunnels, horseshoe shaped in cross section and having a maximum internal dimension of 20.5 feet. At the present time, the water reaches the two turbines in service by a single pressure tunnel 11,000 feet long, and the driving of this tunnel has undoubtedly represented the most difficult part of the task. The contract for this work was let to R. C. Storrie & Company of San Francisco; and virtually from end to end the tunnel pierces a solid mass of rock. The amount of water seeping into the tunnel has been very small; and because of the nature of the rock the work has been pushed forward without recourse to timbering.

As might be expected, rapid progress on an 11,000-foot tunnel could not be made when working inward toward a common goal from only two headings. Therefore, to expedite the excavating of this main pressure tunnel, the contractor drove into the mountain a 10x10-foot adit, 1,260 feet long, which intercepted the line of the main tunnel about mid-length. This enabled him to work simultaneously at four faces. The procedure adopted was that of the well-known top heading and bench method. The top heading was about 7 feet high, and was held as near as practicable to the required maximum section of excavation—that is, 23.5 feet. A round consisted of 32 holes, ranging in depth from 6 to 8 feet, driven by four "Leyner" drills. In this way, an average break of 5 feet was obtained. The heading was kept about 75 feet in advance of the bench so that the heading could be blasted without moving everything down over the bench. The mucking was done

Lower portal of the 5x7-foot tunnel which carries water from Newhalem Creek to Newhalem Power House.

One of the portals of the main tunnel by which water is conveyed a distance of two miles from Gorge Reservoir to Gorge Power House.



Gorge Power House, which is large enough to accommodate six turbo-generators of 37,500 H. P. each. The ultimate capacity of this plant will be 225,000 H. P.

by hand, and the spoils were carried to the edge of the bench by wheelbarrows and dumped over it.

In drilling a bench, about 21 horizontal holes were sunk to a depth varying from 16 to 18 feet. Three rows of holes were generally made—the bottom row being on grade. In the cases of both headings and benches, the charges were set off by electricity and delay-action fuses. At each bench the mucking was done by an air-driven shovel or, to be exact, by a regular steam shovel operated by compressed air. The best record made on any bench was an advance of 540 feet in a month of 27 working days.

The tunnel is lined with concrete having an average thickness of 18 inches; and this lining was placed by means of compressed air in conjunction with steel forms. In the earlier stages of the lining, the concrete was placed in batches of 1 cubic yard at a shot, but the contractor improved upon this performance by devising a gun which could shoot 4 cubic yards at a charge.

This main pressure tunnel delivers 3,000 cubic feet of water per second at a velocity of 10 feet; and before reaching the power house the water is intercepted by a surge tank 1,100 feet away. The water finally arrives at the power house through three steel-lined penstocks, each of which is closed at its lower end by a balanced hydraulic valve. At present, only two of these penstocks supply energy to turbines.

There is nothing especially interesting about the crib-work diversion dam that now directs the waters of the Skagit River into the pressure tunnel. The 11,000-volt current coming from the generators is stepped up to 165,000 volts by transformers, and at this voltage the current is carried by the transmission lines to Seattle, 100 miles away. The transmission lines are suspended above a right of way 300 feet wide. The existing plant represents a cost of $175 per horse-power developed; and Mr. C. F. Uhden, chief engineer of the Skagit project, estimates that the horse-power cost will be only $122 a unit upon the completion of the proposed 240-foot dam and the installing of additional generators.

Two of the 37,500 generators now installed in Gorge Power House.

Should the demand warrant it in the years to come, the City of Seattle would build a 325,000-H. P. station on the Skagit seven miles upstream from the Gorge Power House. This plant, to be known as the Ruby Power House, would receive its operating water from a 28-foot pressure tunnel, 3¼ miles long, tapping a reservoir 23 miles long and capable of impounding 1,300,000 acre-feet of water. To create this reservoir, there would be reared a dam 480 feet high and having a length of 1,000 feet on the crest.

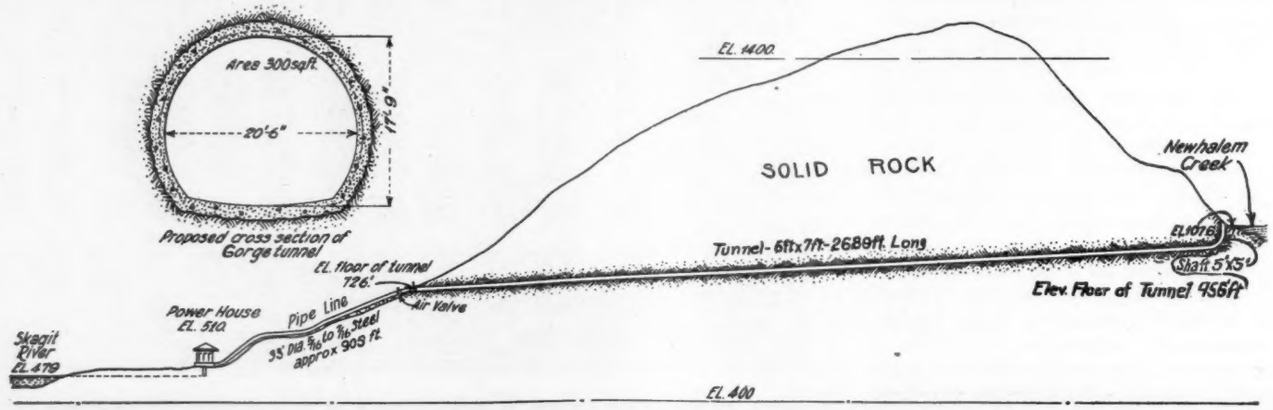
CHANNEL TRAIN FERRY

AFTER satisfactory trial trips, the Harwich-Zeebrugge train ferry has begun regular service between England and Belgium, with six trips weekly in each direction. Two vessels are at present employed, and these make the crossing of 84 miles in from 9 to 10 hours. No new boats were required, as a number of those employed during the war had fully demonstrated their seaworthiness. Each ferry has four tracks, and can accommodate 54 loaded, 12-ton wagons or their equivalent. The advantages of the system are self-evident.

The manufacturing centers of Great Britain are now directly linked by continuous rail service with all the countries of Europe, even with Constantinople; and, eventually, it will also be possible to reach India by an all-rail route. Some difficulty was experienced in finding rolling stock precisely adapted to the slight variations in the gages of several of the continental railways; but this problem was solved by the Belgian government, which agreed to provide cars at its own expense and to lease them to the ferry company.

EXTRACTING PETROLEUM FROM COAL

THE extraction of petroleum from coal by the low-temperature carbonization process is the object of a plant at Nottingham, England. The promoters hope to make Nottingham a smokeless city, to furnish cheap gas, and to reduce both waste and danger in the coal mines in addition to securing from 18,000 to 20,000 gallons of oil from every 1,000 tons of coal—the expected daily capacity of the plant. Under present circumstances, England imports oil to the value of 50,000,000 pounds sterling a year. It is proposed to replace this supply as far as practicable with gasoline and other petroleum products to be separated from small coal heretofore regarded as almost a waste product of the mines.



Cross section of Newhalem Creek development preliminary to work on Gorge Power House. The cross section at the upper left of the cut is a typical section of the 2-mile tunnel which delivers water to the turbines in Gorge Power House.

Mobile, Self-Contained Compressor Car for Railroad Service

By C. STANLEY KULP

ONCE AGAIN the initiative of the West has been shown in the recent development of a compressor car outfit which promises to be of much service in railroad construction work. Credit for this new type of railway equipment belongs to Mr. W. A. Bechtel, a railroad builder of San Francisco, Cal., whose practical experience in the field made it possible for him to foresee the usefulness of such a mobile, self-contained power plant.

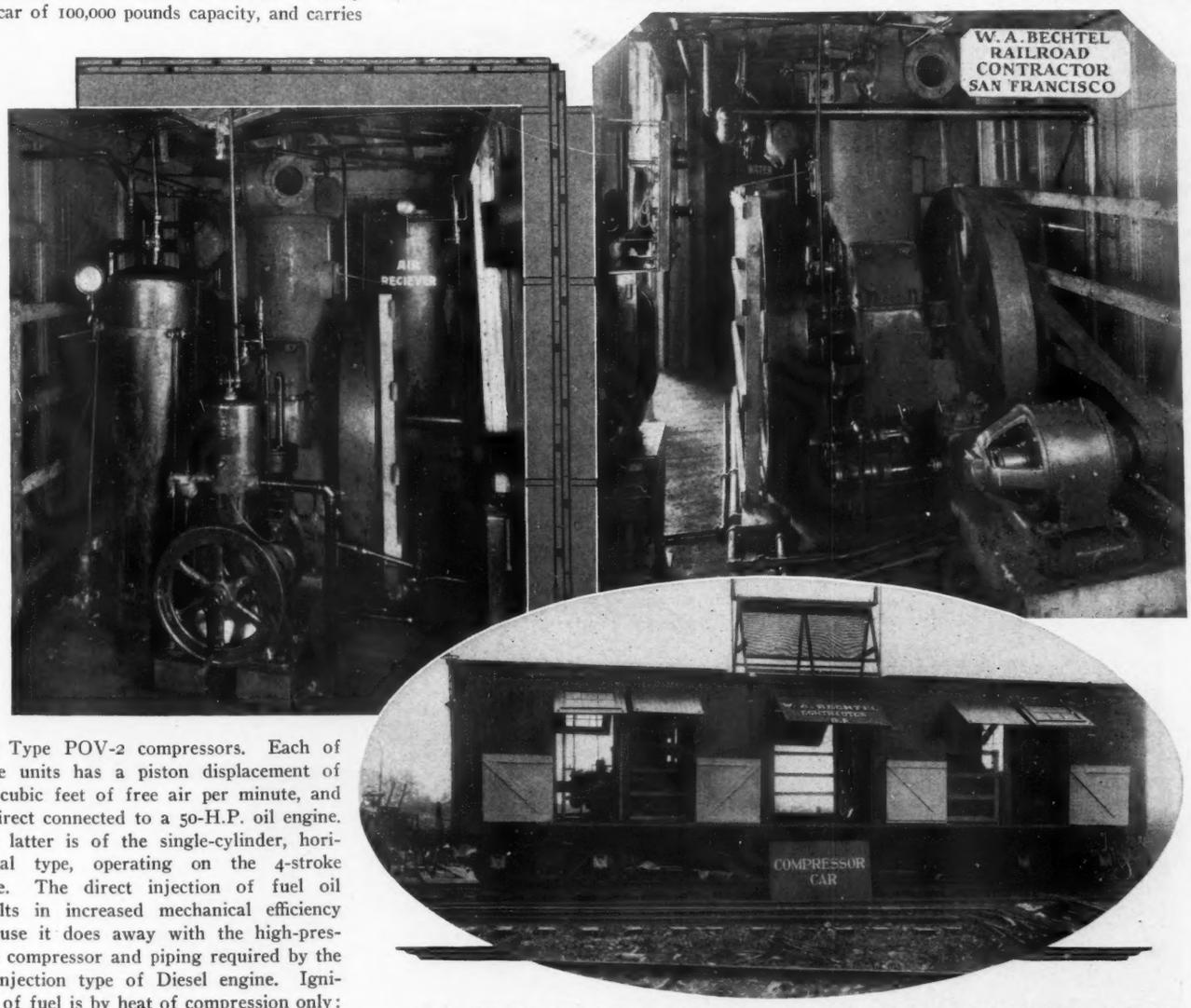
The car, itself, is a standard, steel, fish-belly box car of 100,000 pounds capacity, and carries two Type POV-2 compressors. Each of these units has a piston displacement of 271 cubic feet of free air per minute, and is direct connected to a 50-H.P. oil engine. The latter is of the single-cylinder, horizontal type, operating on the 4-stroke cycle. The direct injection of fuel oil results in increased mechanical efficiency because it does away with the high-pressure compressor and piping required by the air-injection type of Diesel engine. Ignition of fuel is by heat of compression only: there are no hot bulbs, plates, or other forms of mechanical or electrical ignition. The compressors are of the 2-stage type fitted with water intercoolers for cooling the air between stages of compression.

In addition to furnishing compressed air, this mobile power plant will supply current for the lighting of construction camps, tunnels, etc. Current will be provided by a 7-kilowatt General Electric generator, which can be belt driven from either of the oil engines.

A unique feature of this car is the method employed for cooling the circulating water for the water jackets of the compressors. In one corner of the car is a water tank which holds the normal supply. A small, air-driven pump forces the water from this tank through the engine and compressor intercooler to a cooling tower, which is mounted on the roof of the car. This water-cooling tower is A-shaped in design, and has on each side of it a heavy wire screen. Hot water is carried to the top of these screens by means of a distributing pipe, which runs the full length of the tower. The water, in running down over the screens, is cooled and then collected in a basin which has been built into the roof. From this basin the water flows by gravity back into the main tank. This cooling-tower arrangement is portable, and can be set up or removed in fifteen minutes by two men.

This novel air compressor plant was first placed in operation on a contract for the Southern Pacific Company, at Oak Ridge, Ore. When operating on an 8-hour-day schedule, the total fuel consumption of both units amounts to approximately 50 gallons of heavy oil. This exceedingly low cost of producing compressed air certainly justifies the efforts made in designing and constructing the car.

When it is necessary to shift the plant from one job to another, the cooling tower is removed and the roof is replaced over the cooling-tower reservoir. With the doors and windows closed the car, with the exception of the windows, is not unlike a standard box car. The whole outfit as it stands, including the type of car, the location of engines, air receiver, water and fuel tanks, and the arrangement of the cooling system, was worked out by Mr. Bechtel and his engineers, and was assembled and erected at Elmhurst, Cal.



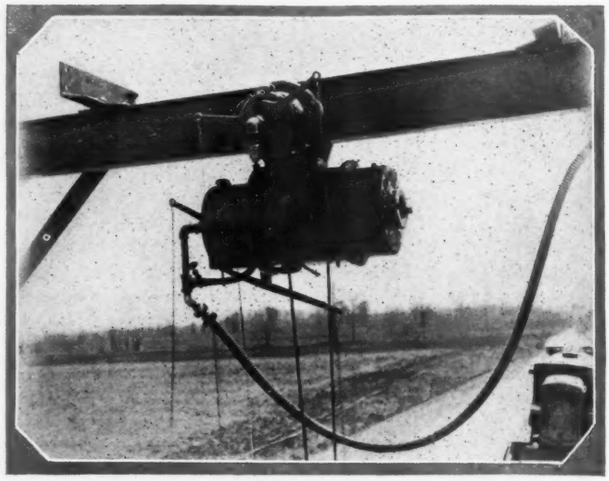
Left—Power plant, showing small compressor unit which supplies starting air for the main 50-H.P. oil engine. Right—The 50-H.P. oil engine drives by belt a 7-kilowatt General Electric dynamo seen in the foreground. Oval—How this novel car looks when ready for service.

Novel and Effective Use of Air-Driven Hoist

By VERNON H. VANDIVER

AT a time easily within our memory nearly all mechanical means for doing work were machines of such size and weight that they were necessarily stationary. Usually, a machine was assembled on its foundation, where it remained a permanent fixture until it could no longer serve its purpose. Today, however, there is a different story to tell. Inventive genius and manufacturing resourcefulness have not only supplied us with machinery for performing well-nigh every class of labor but, what is still more interesting, they have made much of this equipment portable.

Take, for example, the portable air compressor and what it makes possible. The Hill & Hill Construction Company was recently building a stretch of concrete highway near East Orwell, Ohio. Roads leading to the work were of such a nature that heavily laden motor trucks could not pass. The task of transporting materials, therefore, presented a very difficult problem, and the manner in which it was solved is interesting.



This suspended air hoist of 4,000 pounds capacity is moved horizontally by a smaller air-driven motor, which is geared to trolley wheels.

A railway ran alongside the new roadway; but the use of this means of transportation would involve heavy expenditures if the materials required for the job were to be handled in the usual way by manual labor, inasmuch as it would be necessary to load them first on motor trucks at the storage plant; next to transfer them to railroad cars at the freight yard; and then to place the load once more onto trucks at the scene of operation. The men on this job, however, were used to solving difficult problems.

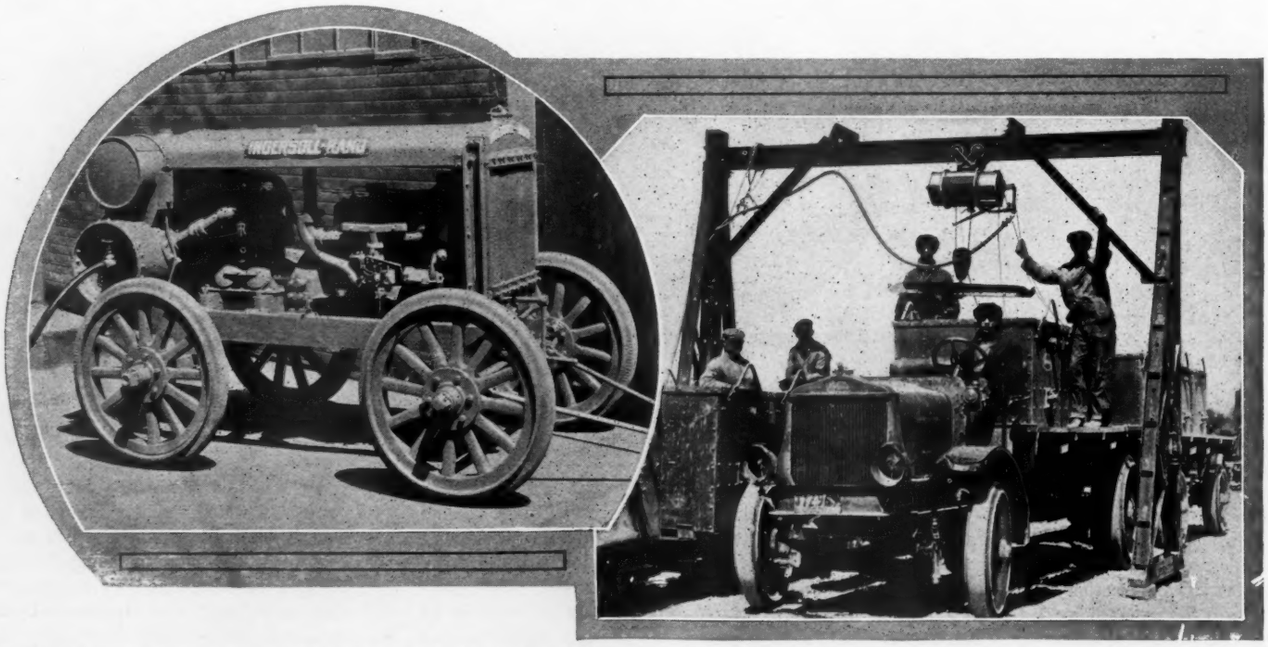
It was decided to mix the materials at the plant and to transport them in steel hoppers. The lifting of the loaded hoppers onto and off the railroad cars had to be done mechanically, and this work was performed by a 4,000-pound-capacity air-motor hoist drawing operative air from a 4¼x4-inch, Type Twenty, portable compressor. This hoist, a product of the Ingersoll-Rand Company, was suspended from an I-beam by a 4-wheel trolley. The I-beam was supported on structural-steel legs—the legs and beam forming a "horse" large enough to straddle both a motor truck and a freight car. This arrangement made it easy to shift the loaded hoist along the I-beam from the freight car to the truck, or *vice versa*. An air-driven motor was geared to the trolley wheels.

In operation, a slight pull on a chain starts the trolley motor and spots the hoist over the hopper, to which the hook block is then fastened. A slight pull on another chain starts the hoist and lifts the load, while an automatic brake holds it in suspension. A pull on a third chain moves the hoist and its load along the I-beam to the desired position, and a pull on a fourth chain lowers the hopper. In this way, one or two men are able to do the work that would require a dozen men if it were done manually.

BOLL-WEEVIL-PROOF COTTON PLANT

AN apparently successful means of circumventing the boll weevil has been worked out by Mr. J. V. Cochran, of Marietta, Ga. By a system of selective cultivation he has produced a cotton plant that practically defies the pest, so far as the destruction of the valuable crop is concerned. The use of poison is necessary only while the stalks are young.

After the bolls have developed, the yield is assured by the increased thickness and hardness of the hull, which the weevil is then unable to penetrate. From a 2½-acre trial patch Mr. Cochran got three bales last year.



Left—Portable compressor which has furnished the operating air for the combination pneumatic hoisting outfit. Right—Air-driven hoisting outfit in action unloading hoppers from a motor truck and trailer.

Subaqueous Torch Widens Its Field of Usefulness

By ROBERT G. SKERRETT

ON THE EAST shore of the East River, in Brooklyn, N. Y., is now rapidly nearing completion the largest of steam-electric generating stations. This gigantic power plant, the property of the Brooklyn Edison Company, will be equipped with eight 50,000-kilowatt turbo-generators, and will, therefore, have a maximum capacity output of 400,000 kilowatts of electrical energy.

The efficient working of turbo units of this size is largely contingent upon the availability of an ample supply of condensing water; and, to this end, provision has been made for a flow of 800,000 gallons per minute. This water is drawn from the East River; and, after performing its cooling function, is returned to that rapidly moving stream. The tunnels by which the water will enter and leave the power house have been built of reinforced concrete and are placed at some depth below the surface of the river at low tide. In connection with this system there is a mammoth screen well; and this well and the tunnels were constructed in an excavation walled off from the river by a cofferdam of exceptional size.

Much of this excluding barrier was formed of heavy steel sheet piling driven deep into the river bed to insure sufficient rigidity to withstand the inward pressure of the water at flood tide. All told, about 500 Lackawanna, arched-webb, interlocking piles were used—weighing 58.1 pounds per linear foot. The piles ranged from 65 to 70 feet in length; and on an average 30 feet of each pile penetrated into the river bottom. So far, so good; but before the tunnels could be used it was necessary to remove 150 of these piles—at least that portion of them rising above the under lips of the mouths of the tunnels.

HOW metals can be cut under water by means of a novel subaqueous torch was described at some length in the Magazine a little more than two years ago.

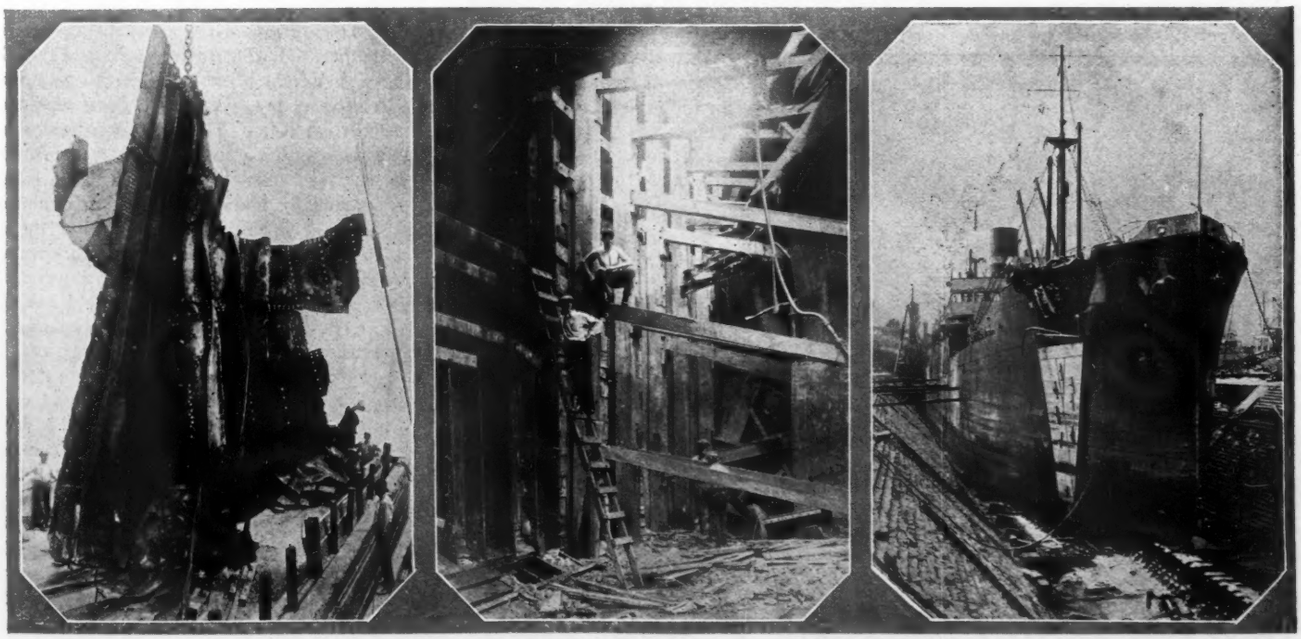
At that time, the merits of the apparatus in the field of marine salvage were emphasized because up to then the invention had been principally used in that direction.

In the meanwhile, however, the torch has proved very efficient in other lines of work; and the performances have made it clear that American ingenuity has produced an adaptable and a thoroughly practical tool capable of valuable service in many departments of human endeavor.

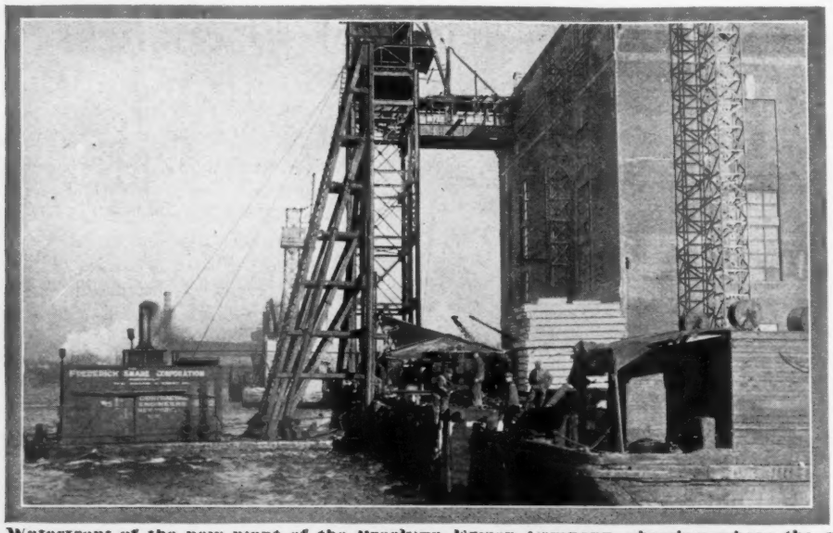
As a matter of fact, it was deemed desirable to cut off the piles along a line which varied from 5 to 8 feet above the river bed. The purpose of this was to leave a steel bulkhead which would prevent the sweeping waters of the river from undercutting or scouring out the earth beneath the tunnels. It might be mentioned here that at certain periods the current of the East River flows at a speed of from 3½ to 4 knots an hour. For several reasons, the general contractor—the Frederick Snare Corporation—decided that this difficult and extensive job could best be done by means of the torch which had previously performed so well in burning through other submerged metal bodies. Therefore, the undertaking was turned over to the International Submarine Company, Inc., the owners of the torch in question.

For the sake of those unfamiliar with the article printed in this Magazine in May of 1922, we might explain that the torch is a combination of a powerful electric arc and an oxygen jet—the intense heat of the arc doing most of the melting while the oxygen serves to sweep away the metal which it also helps to fuse. The gas, because of the pressure behind it, forms a bubble, so to speak, about the arc and holds the water away while the cutting is being done. The diver induces the arc by grounding the circuit—that is, he places the tip of the torch against the metal to be melted and then withdraws it a fraction of an inch. Instantly, the electricity bridges the gap and produces an arc having a temperature of more than 6,000° F. The discharge of gaseous oxygen and the flow of electric current are under the control of the diver, and the torch is "dead" until he reaches his point of operations and is ready to vitalize it.

The tunnels were completed late in February, and shortly thereafter the cutting off of the steel sheet piles was taken in hand. Severe weather added much to the rigors of the work,



Left—Twenty-ton mass of crumpled steel cut free from the damaged hull of the steamship "Andree" by means of the submarine torch. One of the cuts measured 33 feet in length from top to bottom, while a shorter, horizontal cut was made under the turn of the bilge. Center—Within the damaged hold of the "Andree" after the wound was patched and the ship pumped out. Bolt holes for the patch were drilled underwater by means of Little David air drills. Right—Shipping-board steamer "West Columb," damaged by collision in New York Harbor and patched so that she could be drydocked for repairs. The gas-electric torch helped to make this work possible.



Waterfront of the new plant of the Brooklyn Edison Company, showing where the gas-electric torch was used to sever 150 heavy steel sheet piles well below the surface of the river.

Hoisting out one of the big steel sheet piles at the Brooklyn Edison plant after it had been severed by the submarine torch.

Courtesy, Brooklyn Edison Company.

Diver, holding an underwater cutting torch, making ready to descend to the river bed to resume work in severing 15-inch steel sheet piles.

and the strong tidal sweep of the East River made it extremely difficult and at times impossible for the divers to hold their stations on the outer side of the cofferdam, where most of their operations were carried on. The men engaged were skilled divers, of powerful build, and they were obliged to put forth their utmost strength and to employ all their resourcefulness to complete their tasks.

The job was made more troublesome by concrete which had gotten into the interlocked joints of some of the piling and by wooden splines which had been driven in between the steel members to reduce leakage. Owing to the nature of the weather, two divers—employed alternately—worked during each period of slack water and until the tide became too swift for them to keep their positions. The men were under water intermittently from 5½ to 6 hours daily; and, considering conditions, a good day's work consisted of severing from 5 to 7 piles. Later on, when fair and mild weather arrived, the divers worked in pairs; and a record of 10 piles cut in the course of a single day was achieved by one of the men.

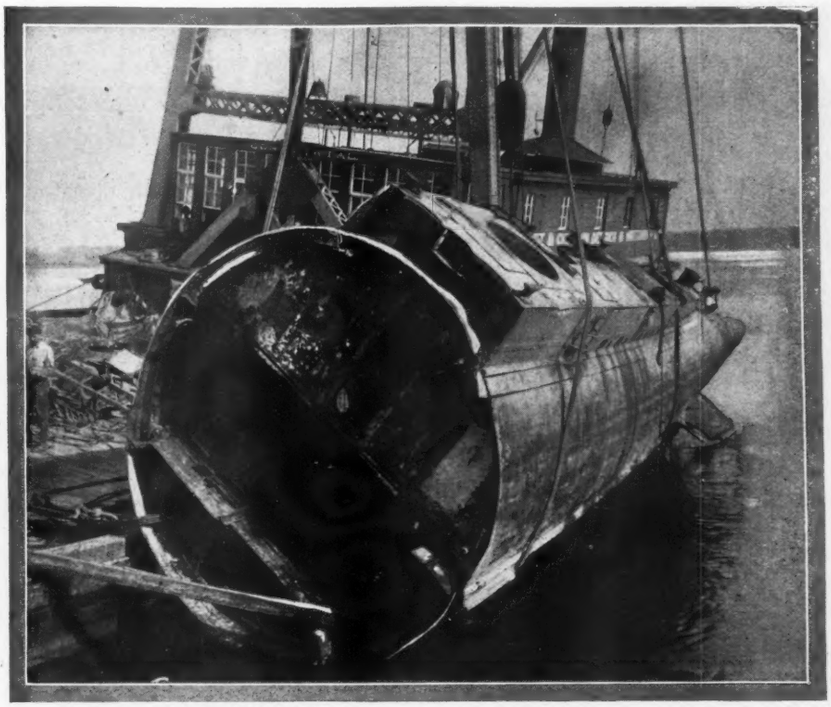
The foregoing use of the subaqueous metal-cutting torch was really a climax built upon two previous successful performances of a kindred character. The first of these was in connection with the construction of a bridge at Schenectady, N. Y. Interlocking steel sheet piling had been driven to form the cofferdams within which the bridge piers were reared. Some of these piles could not be driven down to the prescribed grade; and the contractors, the American Pipe & Construction Company, were required to cut these piles off at a certain depth below the surface of the river. The electric-arc-and-gas torch was utilized; and the excess top sections of 29 Lackawanna steel sheet piles were thus got rid of.

Now for the second undertaking. The Atchafalaya River is spanned at Melville, La., by a Texas & Pacific Railway bridge, built in the "eighties." Owing to increased traffic and the greater weight of moving loads, it was deemed desirable a few years back to strengthen the supporting piers. The engineers decided to do this by erecting a cofferdam of steel sheet piling around each pier, by unwatering each enlarged area, and by filling the space with reinforced concrete. No effort was made after the completion of the work to remove the enveloping steel piling, which reached about seven feet above the water level. This would have been entirely satisfactory but for an unlooked-for accident which occurred later on.

An exceptionally heavy flood swept down the river during the spring of 1922, and carried with it part of a big fender pier. This derelict was composed of something like 120,000 feet—board measure—of timber. When this runaway mass reached Melville it struck, in passing, the end of one of the sheet-pile cofferdams of the Atchafalaya bridge. Among other things, the blow ripped loose and bent outward into the thread of the stream 30 of the interlocking piles. Inasmuch as the river is navigable, the railroad was obliged to take steps to remove the obstruction. After due consideration of the problem, the railway engineers decided it would be impracticable to get rid of the deformed piling either by pulling them out *en masse* or

singly; and the underwater torch seemed to offer the only effective and reasonable means of disposing of the difficulty.

The required outfit was shipped from New York, and the steam-turbine-driven generator set, which furnished electricity for the torches, was installed aboard a local river towboat. Besides, the outfit included a switchboard, diving dress, and numerous flasks of highly compressed gaseous oxygen. Actual cutting was begun about the middle of November, 1922; and the entire task was finished within seventeen working days. In order to facilitate cutting with the torch it was found necessary to remove pieces of concrete from the bent piles, and this preparatory work consumed considerable time.



Aftermost section of the U. S. Submarine "N-4," cut clear of the rest of the hull by the underwater torch so that each section could be handled by a floating derrick. The hull was thus cut into three parts to facilitate reclaiming it from the river bed.

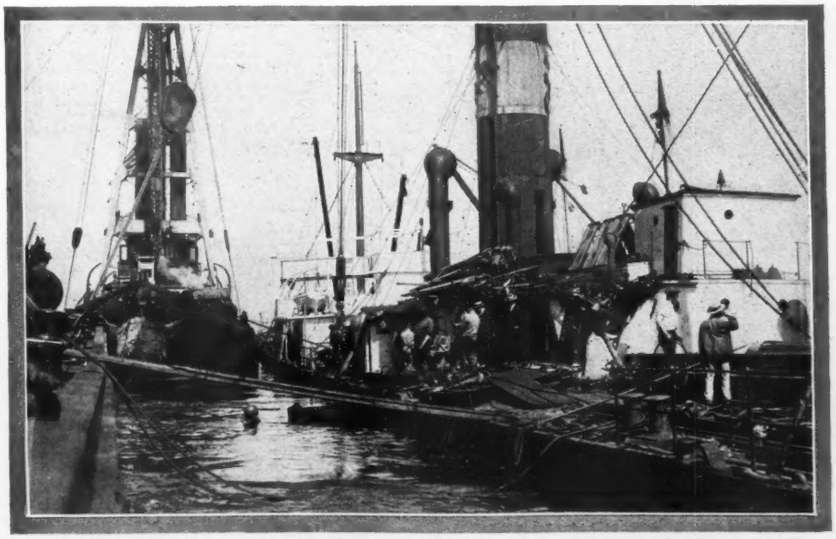
The major part of the cutting was a straight-away operation, but at one end of the cofferdam five of the piles had been so twisted that a second cut was needed to clear away the last of the bent metal. All told, substantially 450 square inches of steel were burned through under water. Each pile was 12¾ inches wide in cross section and had an average thickness of ½ inch. Five piles was the greatest number cut in a single day by the skilled diver. Before the gas-electric torch was decided upon by the railroad engineers, the lowest figure for the completion of the task by any other method was put at $35,000. As a matter of fact, the use of the torch and all charges in connection with it totaled only $5,500. Further, much time was saved.

Water for the operation of the Hammermill Paper Company's plant at Erie, Pa., is drawn from Lake Erie through a 48-inch steel pipe which extends outward from the shore to an intake crib 2,000 feet away. Anyone familiar with a modern paper mill knows that large quantities of water are needed 24 hours a day and continuously for 6 days each week. Failure or even a cutting down of the amount of available water might entail serious loss if not the halting of operations.

For reasons which need not be explained here, air entering the main at times interfered with the working of the pumps upon which rest the burden of drawing water from Lake Erie and distributing it in proper quantities to the different departments of the mill. Therefore, the company planned to overcome this difficulty by having the main feed into a new suction well which would keep the pumps properly primed. That is to say, the main was to be severed within this well, a section removed, and an elbow substituted which would have its lower, open end constantly submerged. The only hitch in carrying out this scheme lay in finding means by which the ⅜-inch shell of the pipe could be cut circumferentially, detached, and the elbow connected all within the shut-down period of 24 hours between 6 a. m. on a Sunday and the same hour on the following Monday.

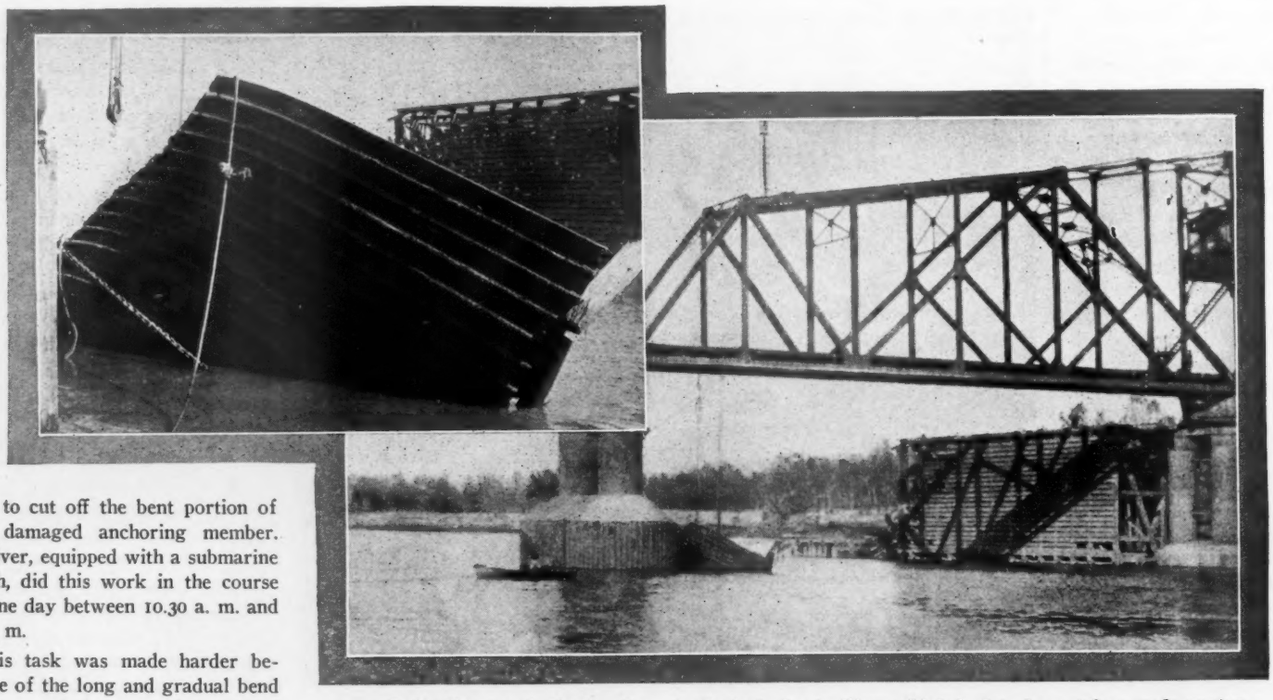
While it was practicable to drain the well, still it was recognized by the engineers that it would be wiser to allow the well to fill so as to equalize hydrostatic pressures when the pipe was cut. It was also apparent that the main could not be cut expeditiously under those conditions unless the work were done by the subaqueous torch. An accompanying sketch illustrates in a general way how the job was executed. After the divers had made a bevel cut the severed section was hoisted clear of the well. Then, by means of bolts, they secured the flange to the replacing elbow. The entire task was finished well within the time set.

A hundred years ago the Chesapeake and Delaware Canal was dug laboriously by hand; and for decades this man-made waterway has proved a helpful transportation artery despite the fact that it is a lock canal but 10 feet deep with a bottom breadth of only 36 feet. In 1919, the Federal Government purchased the canal for approximately $2,500,000; and is today engaged in remodeling the route so that it will be a sea-level waterway with a depth of 12 feet at low tide and a width of 90 feet on the bottom. The excavating is now being done by some of the largest dredges built especially for work of this sort. As is the usual practice, a dredge is anchored or held fixed in any chosen position by dropping a number of vertical spars or spuds, which penetrate the water bed. Means are also provided by which a considerable percentage of the craft's dead weight can be transferred to the spuds to increase her immobility. Manifestly, the spuds have an important function to perform.



Sunken steamship "Andree" and diver descending to cut some of the submerged crumpled hull plating. The ramming vessel drove her bow nearly into the center line of the "Andree."

In some manner, a spud of one of these excavating vessels became bent under water so that it could not be lifted to free the dredge when she was ready to be moved to a new point of operations. The spud in question was constructed of 1-inch steel plating and was 30 inches in diameter. The only way to release the dredge



Left—Bent and displaced part of steel sheet piling which had to be cut free underwater. Right—Bridge at Melville, La., across the Atchafalaya River, showing the pier from which the torn cofferdam projected into the fairway.

was to cut off the bent portion of the damaged anchoring member. A diver, equipped with a submarine torch, did this work in the course of one day between 10.30 a. m. and 5 p. m.

His task was made harder because of the long and gradual bend in the spud that extended upward nearly to the bottom of the vessel. This necessitated severing the spud close to the hull; and to do this the diver had to hold his torch well above his head. Notwithstanding the awkwardness of his position for much of the time and the size of the job, the diver completed his work by making a single, circumferential cut.

While undergoing scrapping at a yard on the Delaware, the old *U. S. Submarine N-4* sank at the dock when the swells of a passing steamer caused the underwater craft to roll over and fill. The weight of the submerged vessel was close to 240 tons; and the largest floating derrick available for raising her could safely lift a maximum dead weight of but 80 tons. To salvage the craft, she was cut into three sections or pieces of approximately equal weight so that each of them could be handled separately by the floating derrick, lifted clear of the water, and placed on cars running upon the nearby wharf. Space forbids giving the details of this undertaking, which was both novel and interesting and which was replete with thrills and difficulties. The gas-electric torch did the work, and made it possible to reclaim at a modest outlay the submerged submarine so that her metal might be sent to the melting pot to serve peacetime purposes.

WORLD'S LONGEST AQUEDUCT

THE APULIAN aqueduct building in Italy will be, when completed, the longest in the world, though not of the greatest capacity. Several of the provinces which form the regions known as Apulia and Basilicata have suffered through the ages from lack of water; and their geographical position and geological formation are such that the only remedy lay in bringing water to them from the western side of the Apennines.

A law providing for the construction of the aqueduct was enacted in 1902; and the work was begun in 1905 according to plans prepared by Italian engineers. The undertaking entailed the building of a main aqueduct about 140 miles long, of which over 60 miles had to be carried through the Apennines in tunnels. From the main aqueduct spreads a network of subsidiary branches having a total length of 1,000 miles. This will carry water to five provinces and supply the needs of 2,500,000 people.

The Government of San Salvador is showing a marked interest in roadbuilding, and much improvement along this line is expected. The governor of each department has been presented with an automobile by the president of the republic for the purpose of stimulating an interest in better highways; and each governor must regularly report on the condition of the roads in his territory as determined by the use of these machines. Let us hope this experience will not be bitter.

According to estimates just compiled, we learn that about 107,200,000 tons of stone, valued at $161,600,000, was produced in the United States in 1923. This represents an increase in quantity of 33 per cent. over the output of 1922 and of nearly 17 per cent. over 1916—the record year.

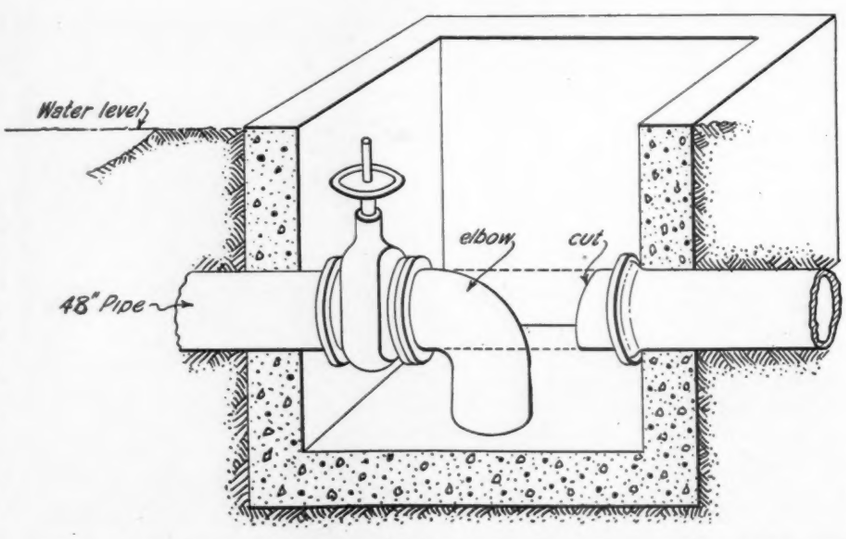


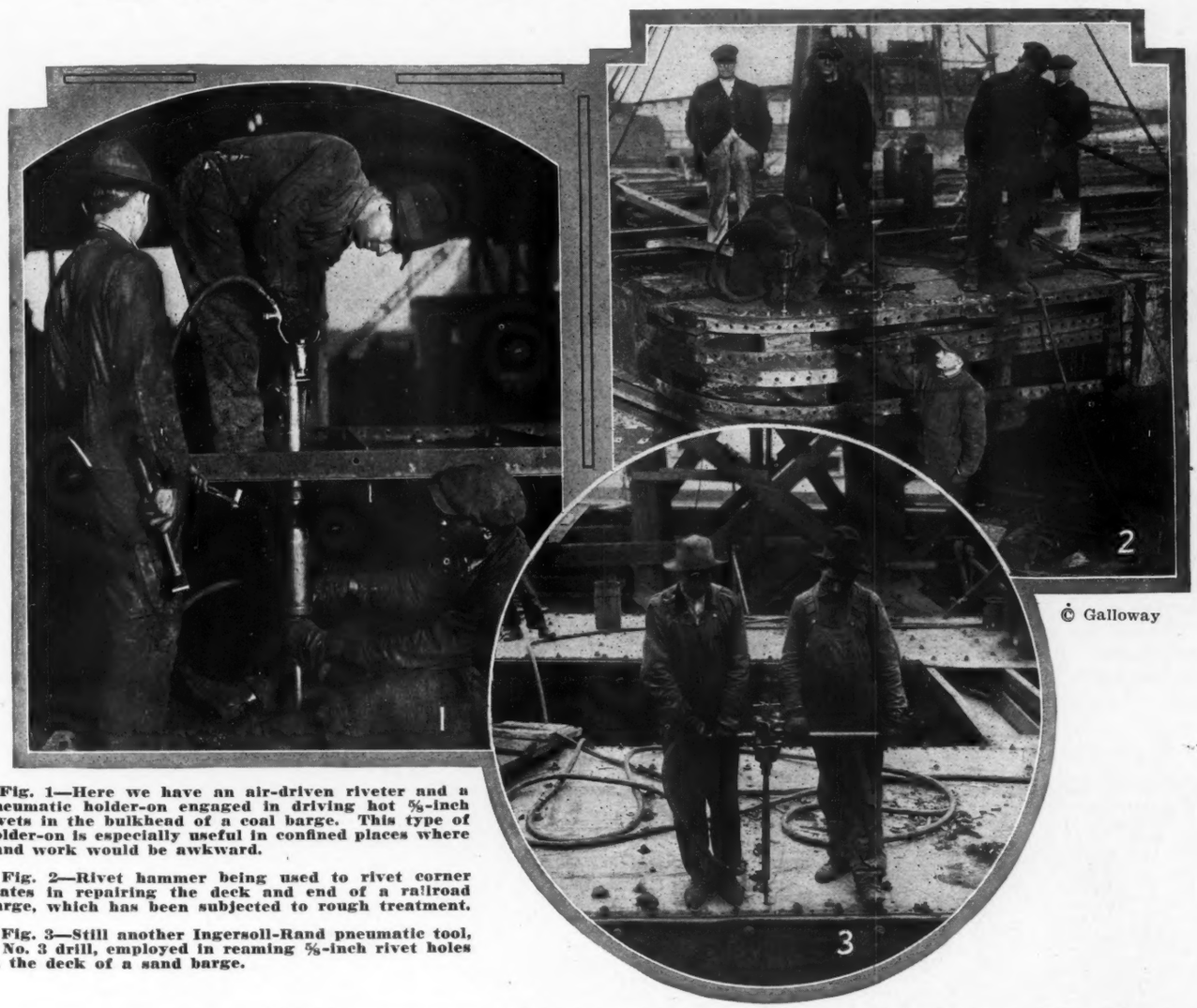
Diagram illustrating manner in which the 48-inch water main of the Hammermill Paper Company's plant at Erie, Pa., was cut and fitted with an elbow.

NEW WATER TUNNEL FOR CHICAGO

THE water system of Chicago has been growing or developing for more than 60 years, but the consumption of water has kept constantly ahead of the supply. Originally, there was a wood pipe, 30 inches in diameter, that ran out into the lake for a distance of 600 feet. Then, in 1867, the first tunnel was started. This had a diameter of 5 feet and extended to a crib 2 miles from shore. In 1876 another bore, 7 feet in diameter, was driven to the same crib; and, more recently, a third and similar tunnel was constructed. Towards the end of the "eighties" a second crib was erected with a 3-mile tunnel, having a diameter of 10 feet.

All four of these tunnels are now insufficient, so a fifth one is to be built to connect with the latter crib. For a stretch of 4,100 feet this newest tunnel is to have a diameter of 16 feet, and is to be driven through solid rock; then for 11,000 feet, also through rock, it is to be 13 feet in diameter; while the last 13-foot section, through clay, is to have a length of 26,740 feet. There are also to be branch bores 8 feet in diameter. The cost of this extension to the water-supply system is estimated at $8,725,000.

AIR-DRIVEN TOOLS SPEED UP THE BUILDING AND REPAIR OF FREIGHT BARGES



© Galloway

Fig. 1—Here we have an air-driven riveter and a pneumatic holder-on engaged in driving hot ⅝-inch rivets in the bulkhead of a coal barge. This type of holder-on is especially useful in confined places where hand work would be awkward.

Fig. 2—Rivet hammer being used to rivet corner plates in repairing the deck and end of a railroad barge, which has been subjected to rough treatment.

Fig. 3—Still another Ingersoll-Rand pneumatic tool, a No. 3 drill, employed in reaming ⅝-inch rivet holes in the deck of a sand barge.

MARVELOUS BEAUTIES OF CARLSBAD CAVERN

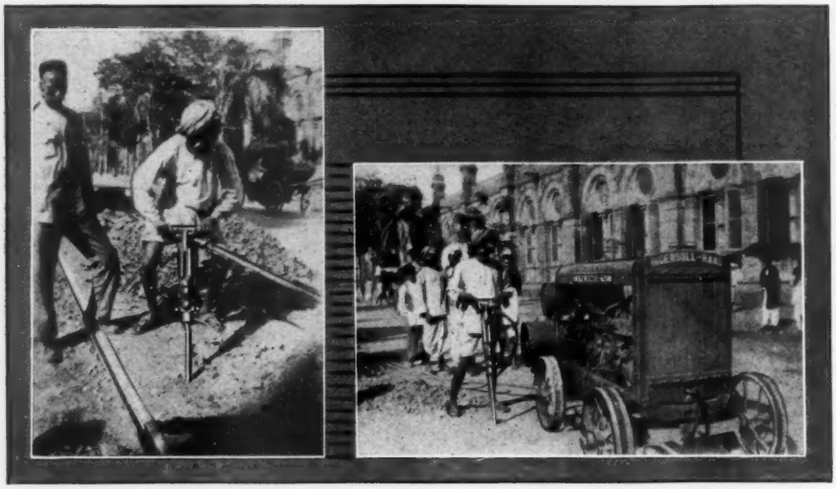
CARLSBAD CAVERN is the name that has been given to the latest find added to our numerous unrivaled natural curiosities. This unique cavern, believed to be the largest in the world, was discovered in a curious way by Dr. Willis T. Lee of the United States Geological Survey. Sent to examine proposed dam sites on the Pecos River, Doctor Lee found the underlying beds stratified with soluble gypsum and salt deposits, which explained why the waters of the Pecos would not stay in their reservoirs.

Tracing the rock strata back some miles to the foothills of the Guadaloupe Mountains, which lie athwart southeastern New Mexico, he came across a great cavernous limestone formation and, incidentally, heard of a "bat cave" from which guano had been shipped to the coast. He descended to a depth of 170 feet in a basket used for hoisting the fertilizer; and, as he began to investigate, it dawned on him that he had struck one of the wonders of the world. Doctor Lee stood at the entrance of a most stupendous cave formation.

As he made his way for 7 or 8 miles, descending 1,000 feet or more in his progress, he passed through lofty galleries and huge amphitheaters with antechambers and disappearing side passages, all decorated with stalactites and stalagmites each differing from all the rest in endless variety. The cavern and the surrounding region of similar characteristics are to be thoroughly and carefully explored, having been made a national monument by presidential order and thus reserved for the people against possible private exploitation. More astonishing revelations are predicted as the labyrinthian vastnesses are further penetrated.

BOMBAY WELCOMES PORTABLE COMPRESSOR

MODERN demands for work well and quickly done have led to the introduction of labor-saving machinery even in the Orient. The glamor of things ancient now mingles with the bustle of the present. We have evidence of this in far-away India. Much interest has recently been aroused in Bombay by the performances of a portable air compressor and pneumatically operated paving breakers, used by the Bombay Electric Supply & Tramways Company, Ltd., to tear up the macadam surfacing of Hornby Road preparatory to laying new rails for street cars.



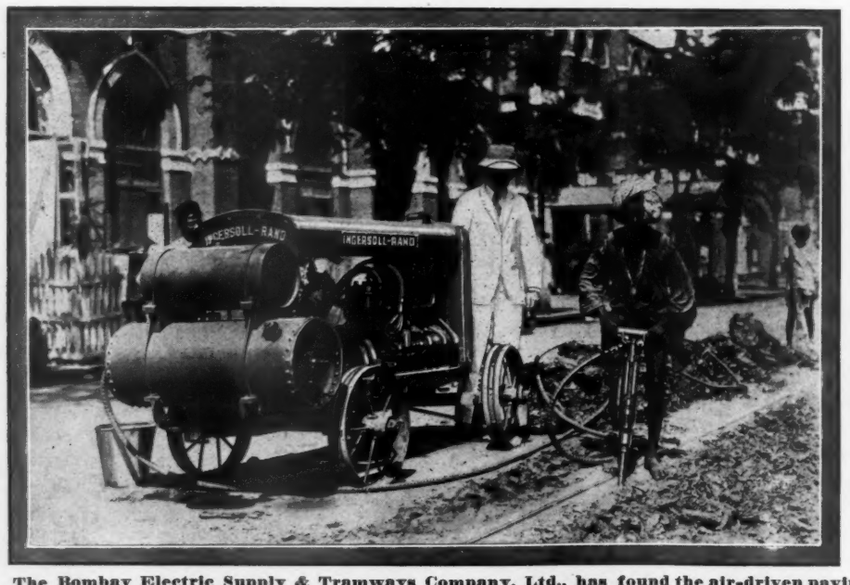
Air-driven tools and portable compressors are no longer novelties in the streets of ancient Bombay.

The paving breaker is a powerful, air-driven hammer that delivers a series of rapid blows to a solid hexagon steel, forcing it into the hardest concrete. It is variously used for tearing down engine and other foundations, for breaking out reinforced-concrete floors and the like, as well as for removing pavements for one reason or another. Although the tool is capable of doing these things, still it is not too heavy for an ordinary coolie laborer to manipulate it very satisfactorily.

The portable compressor, likewise of Ingersoll-Rand make, is also used by the tramway company to furnish air for the operation of a close-quarter pneumatic drill for boring bond, tie-bar, and rail-joint bolt holes in new rails. This drill is particularly suited for working in confined places and will drill, ream, and tap holes up to 1¼ inches in diameter.

According to *The Times*, of India, the tramway company officials declare that the equipment in question has resulted not only in the work progressing much faster than if done by hand but it has also proved to be cheaper—the paving breaker alone replacing eighteen coolies with hand picks, while one close-quarter drill does the work of twelve pairs of hand drillers. Further, we are told that the reduction in cost thus secured is an important feature which is frequently not appreciated in India, where labor is considered cheap but where, in the absence of machinery, the large amount of labor required makes the outlay heavier than is generally realized.

The 5x5-inch portable compressor shown in action has a displacement of 91 cubic feet per minute, and is operated normally by gasoline or, as the British call it, petrol.



The Bombay Electric Supply & Tramways Company, Ltd., has found the air-driven paving breaker and the portable compressor effective in tearing up macadam paving preparatory to laying new rails. The Indian coolie has readily learned how to handle these modern American facilities.

INCREASED EFFICIENCY IN STEAM-ELECTRIC PLANTS

THE Department of the Interior, through the Geological Survey, has recently published an interesting summary of the annual production of electricity and the consumption of fuel by electric public-utility plants for the years 1919 to 1923, inclusive. This report shows the trend during the last four years in the production of current by the use of water power and by the consumption of coal, oil, and gas.

In 1919, there was generated for public service about 39,000,000,000 kilowatt-hours of electrical energy. In 1923, the output had grown to 55,700,000,000 kilowatt-hours—an increase of over 43 per cent. in four years. The increase in the efficient use of fuel at public-utility power plants during these four years has been remarkable. In 1919, a ton of coal produced 625 kilowatt-hours of electricity, while in 1923 the same quantity yielded 835 kilowatt-hours—a gain in the efficient utilization of this fuel of 33 1/3 per cent.

Water-power development is, apparently, not holding its own with steam-power development. In 1919, we obtained from our falling waters 37.5 per cent. of the total electric current generated by public-utility plants. This percentage was gradually reduced to 34.8 per cent. in 1923—19,330,000,000 kilowatt-hours. To have produced this energy by the burning of fuel would have meant the consumption of 23,250,000 tons of coal valued at more than $100,000,000. The amount of power produced at hydro-electric stations depends, of course, on the available water, and a year of more than normal supply throughout the United States would undoubtedly increase their output, that is, their ratio.

In the production of electricity by the use of water power, California ranked first from 1921 to 1923, with 21 to 22 per cent. of the total for the United States. New York, which led in 1920, now stands second with about 18 per cent. of the total. In the production of electricity by fuel, the leading three states in 1920 in the order of their importance were: New York, Pennsylvania, and Ohio. In 1923, Ohio's place was taken by Illinois. In the consumption of oil for the generation of electricity, California stood first in 1920, with 43 per cent. of the total, while Texas was second, with about 22 per cent. In 1923, California was first with a little over 22 per cent., and Texas was second on the list with about 21 per cent. Rhode Island, which ranked eighth in 1920, advanced to third place in 1923. However, the relative standing of the seven states that lead in the production of electricity has remained the same for the last four years. New York is first, with nearly 16 per cent. of the total for the United States; Pennsylvania is second, with about 10 per cent; and California is third, with a little more than 9 per cent.

Waging With Oil a Winning Fight Against Corrosion

By THE STAFF

CORROSION, rust, and decay are all natural enemies against which man must wage incessant warfare. It would hardly be possible for anyone to select a more suitable place for corrosion and decay than a railway roadbed. All the materials that go into its make-up are exposed to dampness, to steam-laden air currents from passing trains, and to dirt and dust carried by the winds. At intervals, the year round, passing refrigerator cars drip brine onto the roadbed; and in the colder regions the tracks are covered for varying periods with snow and ice. In fact, conditions are so unfavorable that the work of protecting railroad trackage from natural chemical reactions represents a very serious problem.

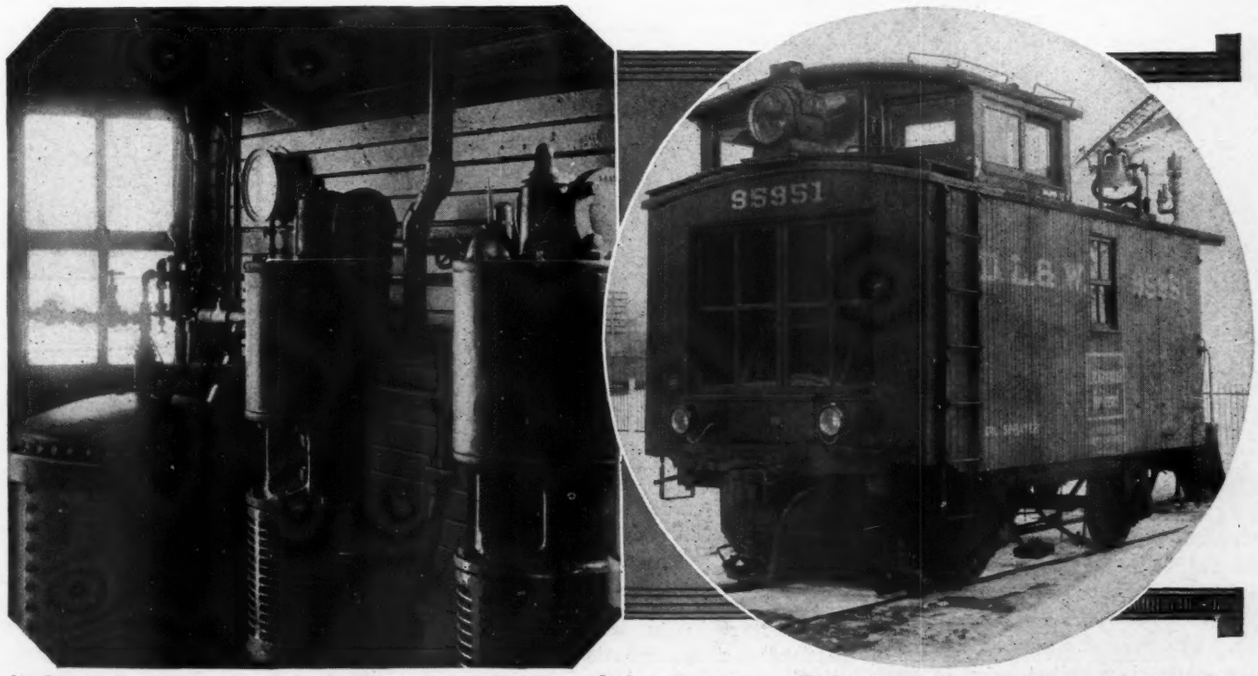
Spraying train ready to begin its work. The sprayer car heads the train, which is pushed by the locomotive.

Let us consider here the case of the Delaware, Lackawanna & Western Railroad—an important system embracing some 2,678 miles of tracks in the populous States of New York, New Jersey, and Pennsylvania. Prior to 1910, the average life of the roadbed, including rails, bolts, ties, tie-plates, and spikes, was only from eight to ten years. This meant that each year 10 to 12½ per cent. of the entire cost of materials and labor required to lay new tracks throughout the system had to be charged against operating expenses. In other words, an average of approximately 300 miles of the line had to be torn out and replaced every twelvemonth. This enormous outlay did not include the expense incurred in the up-keep of old tracks, or the cost of operating and maintaining rolling stock and terminals.

With the increasing demands made upon the Delaware, Lackawanna & Western, the problem of lengthening the life of the track structure—of winning the fight against corrosion and decay—was of such importance that every effort of its engineering department was bent toward that goal. Astonishing success has attended their labors. In 1910, the use of creosoted ties was adopted. This augmented the average life of the ties to sixteen years. It was then desirable to add a like number of years to the life span of the metal parts of the roadbed. Consequently, heavy, high-carbon steel rails, heavier tie-plates, screw spikes, and better quality track bolts were adopted.

The experience of the Delaware, Lackawanna & Western from 1910 to 1914 clearly indicated that it would be a serious mistake to increase the weight of the rails, tie-plates, etc., to meet the longer life of the treated ties without regularly applying a suitable corrosion preventative to the metal parts. The corrosion that took place during that period showed conclusively that in from eight to twelve years the screw spikes and other fastenings would be entirely destroyed.

There were known ways of preventing corrosion, even under the adverse conditions of the roadbed, but none of them was practical. Paints could be applied; but the cost would be prohibitive. Parts could be galvanized or coated with aluminum; but here again the cost factor would be too great. The problem was thoroughly gone into, and numerous tests were made. As a result, it was determined that an oil containing 45 per cent. asphaltum and 55 per cent. crude oil, when applied hot



Left—Inside the oil-spraying car, showing two compressors and the air receiver. Right—Front view of oil-spraying car. The spraying nozzles are seen beneath the car straddling both rails.

once a year, would fulfill the requirements. Manifestly, the oil could not be put on by hand. The question then arose: By what method can the application be made most economically? Some time was spent in experiments along this line; and eventually the Neafie oil sprayer was developed.

During 1914 and 1915, the Delaware, Lackawanna & Western—under the supervision of Mr. A. J. Neafie, principal assistant engineer and inventor of the method—outfitted a flat car for the pneumatic spraying of oil on rails and track fastenings. This car carried various operative and control apparatus, among which was a steam-driven air compressor. The layman, accustomed as he is to seeing paints and oils laboriously laid on by brush, may be surprised to learn that the new oil sprayer applies a smooth, even coat of a highly viscous oil to all metal parts of the roadbed at the rate of from 20 to 25 miles an hour. This statement, however, is founded on fact.

In service, the sprayer car was pushed ahead of a train of tank cars containing asphalt oil. Each tank car was provided with heaters drawing on the locomotive for steam to heat the oil. Steam from the same source was also used to operate the air compressor. Air at a pressure of 30 pounds per square inch was piped to the dome of the tank cars, and in this way the oil was forced through strainers to the spray nozzles located at the head of the spray car. There were four of these nozzles, one for each side of each rail. For spraying, air at a pressure of 60 pounds per square inch was supplied to the nozzles. The spray was so adjusted that the rails, except the heads, and all track fixtures were oiled to a point one-half inch outside the tie-plates.

In the fall of 1915, about 800 miles of track was oiled with the sprayer in but ten days at a cost—including material, train service, and labor—of only $4 per mile. Besides protecting the metal parts, the oil lubricated the ties adjacent to the tie-plates—thus retarding mechanical destruction of the wood due to grit, sand, etc., and checking decay around the spikes by getting under the plates and sealing the cut wood fiber. In this way the life of the ties was also increased.

In order to protect the operator as well as the mechanism from the weather and to improve the functioning and control of the oiling, there was constructed, in 1916, a completely housed-in air-operated car. In it were incorporated such improvements as operations during the previous season had shown to be needed. The spraying apparatus was so arranged that its speed could be adjusted instantly to handle 100 gallons per mile or to give a lighter or a heavier application of oil, as desired.

Prior to the use of oil, fully 50 per cent. of the track bolts that were removed when taking up old rails had to be destroyed because corrosion had caused the nuts to stick so fast to the bolts that it was necessary to break them off. Bolts could not be kept tight without frequent renewal. With this form of protection, however, fully 95 per cent. of the bolts can be tightened or reclaimed. This item alone justifies the expense of spraying.

Divers using a "Jackhamer" and an air-driven pick in doing work on the Newport and Alexandra docks at Newport, Wales. These docks are the property of the Great Western Railway Company, and when it became necessary to make certain alterations to them beneath the harbor surface the tools in question were successfully utilized. Air for the operation of the "Jackhamer" and the pneumatic pick was supplied by a 6x6-inch, Type Fourteen, portable compressor, which was readily moved to the scene of operations.

WOODPECKERS EAT PUTTY

IN Sully, Iowa, the woodpecker has given the ornithologists a new nut to crack. The theory has been that the woodpecker pecks for worms and insects alone, but it seems that its appetite has a wider range. There is a large tank in the town which holds its supply of water. In 1922, the woodpeckers drilled so many holes through the wooden casing of the tank that its insulation against freezing was destroyed. The holes were filled with putty, and the putty was painted over. This makeshift sufficed for the succeeding winter; but in the summer of 1923 the woodpeckers got the paint off and picked all the putty out of the holes. In a cold snap last winter the water supply suddenly gave out; and upon investigation the tank was found to be filled with ice—the putty filling being all gone. Now a new and up-to-date plant is to be provided; and what will the woodpeckers do then, poor things?

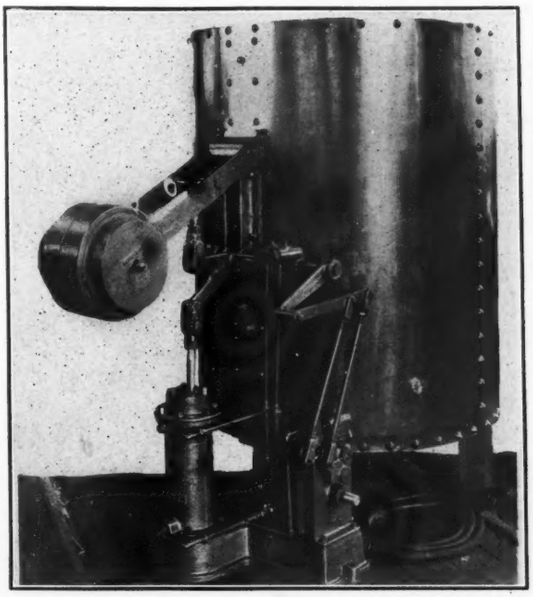
A plant is being constructed at Bussi, Province of Abruzzi, Italy, for the manufacture of synthetic ammonia by the Claude process. In this connection it is interesting to note that surplus power, generated by the station that supplies Naples with current, is to be utilized in the production of the ammonia.

New Air-Controlled Electric Mine Hoist

By H. V. HAIGHT

TWO hoists recently built in Canada for mines in Porcupine have a number of features which are believed to be novel and interesting. One of the hoists was purchased by Coniagas Mines, Ltd., for their Newray option at Schumacher, and the other was procured by The Porcupine Davidson Gold Mines, Ltd., for their property at South Porcupine.

The hoists are of the double-drum type—the two drums being on one shaft and intended to operate normally in balance. Both drums are, however, provided with band friction clutches, so that either drum may be worked independently. The drive is through single-reduction, Falk, herringbone gearing—the gear being of cast steel and the pinion of forged steel, formed integral with the pinion shaft. The motor in each case is a 250-H.P., 550-volt, 60-cycle, slip-ring hoist motor, built by The Canadian Crocker-Wheeler Company; and each hoist is designed for a maximum rope pull of 12,000 pounds and a depth of 2,000 feet.



Liquid rheostat showing counterweight and pneumatic control.

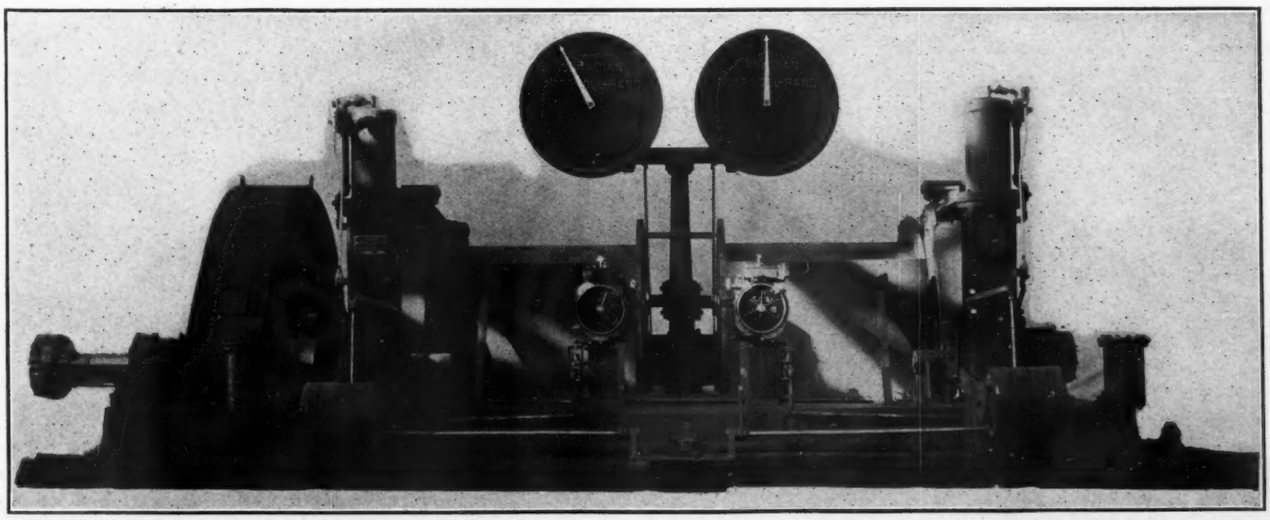
The Newray hoist has drums 60 inches in diameter and 48 inches long; a rope speed of 800 feet per minute; and is designed for 10,000 pounds unbalanced load, while the Porcupine-Davidson hoist has drums 72 inches in diameter and 48 inches long; a rope speed of 1,000 feet per minute; and is designed for 8,500 pounds unbalanced load. The brakes, friction clutches, liquid rheostat, motor-acceleration control, circuit-breaker reset, primary reversing oil switches, primary switch interlocks, reverse protection in case of overwind, emergency stop, and brake regulators for emergency stop are all operated by compressed air, and we will describe these parts in the order in which they are named.

The brakes are of the post type with parallel motion and stops to give equal clearance all around when released. The brake blocks are sectionalized for easy renewal and, in this case, are of basswood. Their dimensions, however, are the same as those of standard asbestos brake blocks. The brakes have floating gear arranged in the usual way to make the brakes follow the motion of the hand lever. The air cylinder is at the top of the brake engine and is controlled by two poppet valves actuated by a hardened cam. There is no oil gag pot. The use of poppet valves instead of piston valves is an important point. Piston valves require a certain amount of lap and permit some leakage, while poppet valves, which need no lap and are perfectly tight, give accurate control and allow no creeping. Rubber seats are used, so that the valves never have to be ground.

This air brake may be compared to the oil brake often embodied in hoists of this type. The oil brake calls for a pair of oil pumps with its motors, as well as an accumulator and a sump. The air brake, on the other hand, draws on the usual compressed air supply for normal operation. If the mine has but one compressor, the hoist will have a small compressor with motor and receiver for emergency supply—the cost of the auxiliary compressor being much less than the cost of two oil pumps and an accumulator. Compressed air is much cleaner than oil, which has a tendency to get all over the hoist. Furthermore, compressed air takes smaller pipes and valves than the oil. The brake shown in Fig. 1 was found, on test, to follow the motion of the hand lever accurately and to be absolutely "dead beat," that is, there was no rebound. When the hand lever is moved the brake piston starts quickly and then slows up, comes to its new position precisely, and stops. That appears to be all that is required of a brake engine.

The clutches are of the band friction type operated by a collar sliding on the shaft. One of our illustrations shows a separate clutch band, while in another can be seen the air cylinders which function the clutches. The valve that actuates the clutch cylinder is under the operator's platform and is similar to the brake valve, consisting of two poppet valves operated by a cam on the hand lever.

The hand levers of the brake and clutch for each drum are interlocked so that both cannot be disengaged at once. Either drum may be



Front view of the 12,000-pound hoist with the operator's platform removed. The Lilly controllers appear directly beneath the two indicator disks.

hung up in the shaft by setting the brake and releasing the clutch. When one drum is thus hung up the other can be operated by the motor. It is impossible, however, to let a drum run free—in other words, the arrangement is safe.

The principal advantage of a liquid rheostat over those types using metal resistances is that a very gradual change in the resistance is practicable—the motor, consequently, coming up to speed more evenly. This reduces the strain on the ropes and connections and lengthens their life. Moreover, there is no danger of the resistance burning out or of starting a fire from overheating.

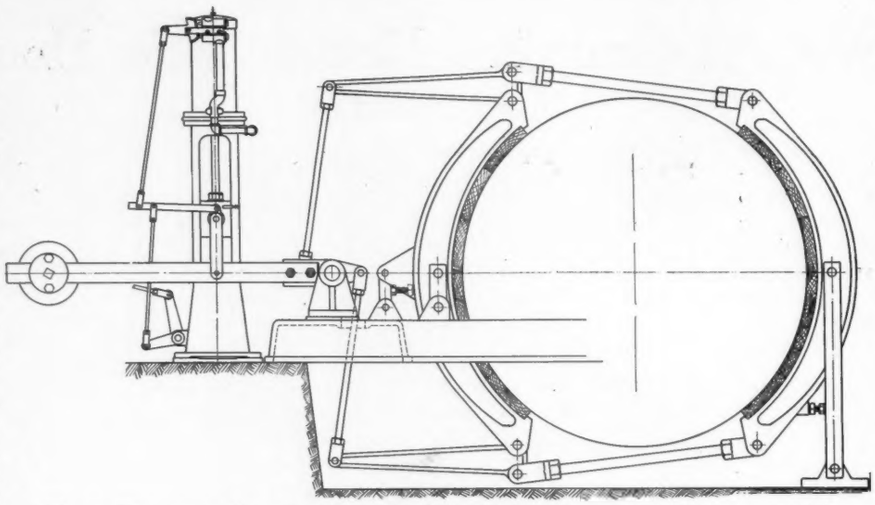


Fig. 1—Diagrammatic cross section of air-brake arrangement on the Newray hoist.

The rheostat consists of three tanks, each having a fixed electrode in the bottom as well as a movable one which is lowered into the liquid until it touches the fixed electrode. The fixed electrodes are connected to the rotor circuit, while the movable electrodes are connected together and to earth. The movable electrodes are counterweighted by the cast-iron weight seen in the foreground of the picture. The counterweight is raised by the air cylinder—the electrodes then descending by reason of their own weight. This arrangement is adopted so that when the air is "off" the rotor circuit is open. In fact, every function is so regulated that the hoist goes to "safety" if the air pressure fails either by accident or intent. The electrolyte is cooled by a coil cooler, that is, it is drawn from the tanks by a circulating pump, forced through the cooler and then sent back into the tanks.

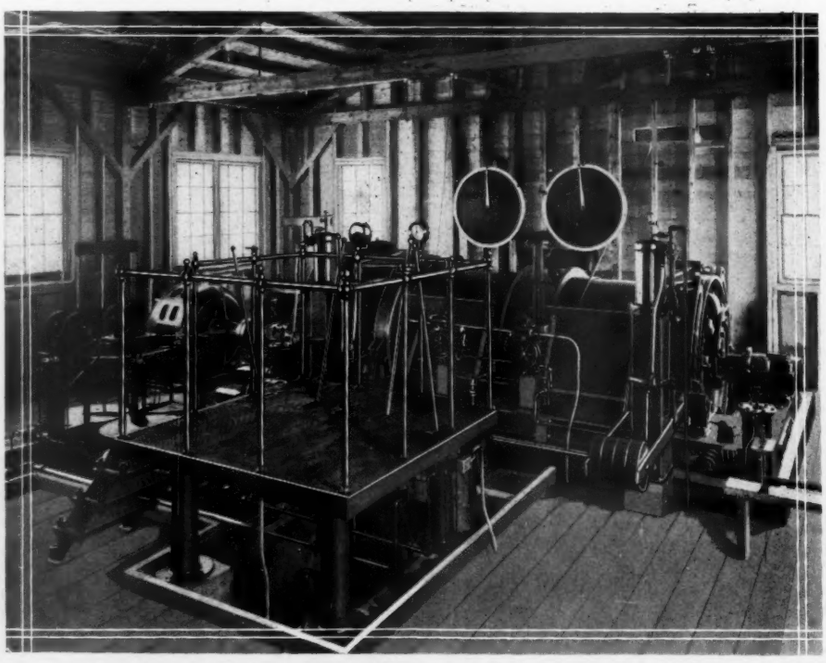
The air cylinder on the rheostat is controlled by a valve on the controller which is connected through levers, rods, and shaft to the hand lever on the operating platform. If the hand lever is shifted slowly the movable electrodes will follow the action of the hand lever, but if the hand lever is moved quickly the electrodes will follow at a predetermined rate. The rate at which the electrodes are lowered into the liquid determines the time in which the motor is accelerated. This time of acceleration is regulated by the acceleration valve.

This valve is located on the operator's platform. When wide open it permits the motor to accelerate at the maximum rate for hoisting ore, and when partly closed it restricts the flow of air and causes the motor to accelerate more slowly for hoisting men. An electric switch is connected to the acceleration valve for the purpose of automatically showing a green light in the stations when ready to carry men.

If the circuit breaker should open it may be reset from the operator's platform, but only in case the motor is "off," or both brakes are "on." On the switchboard, as shown in Fig. 2, there is an air cylinder, A. When compressed air is admitted to the bottom of this cylinder it forces up the toggle that closes the circuit breaker and also pushes up on lever B, closing the no-voltage release, N. When the air is exhausted, the piston to cylinder A drops but leaves the rod hanging up, so that the circuit breaker is free to open again. At the same time lever B falls, leaving the no-voltage release ready to drop once more.

Air is admitted to cylinder A through three valves placed in series on the operator's platform. When all three of these valves are open, air enters cylinder A and resets the circuit breaker. When any one or more of these valves are closed air leaks out of cylinder A, and the circuit breaker is free to open again. The three valves are located as follows: one is at the central position of the motor control lever and is opened by a cam on the motor control lever whenever that lever is in central or "off" position, and the other two valves are at the forward ends of the slots for the brake levers—which is the "on" position—and are operated by pushing forward lightly on both brake levers at once. The safety feature of this reset will be explained more fully later.

The circuit breaker is at the left in Fig. 2. The other switches are primary reversing oil switches. The reversing switches are of the same design and use many of the same parts as the circuit breaker, but they have only four poles each. The circuit breaker and the reversing switches were manufactured by the Monarch Electric Company of Montreal; but the pneumatic devices for operating them were supplied by the hoist builder, the Canadian Ingersoll-Rand Company, Limited. The reversing switches are operated by air cylinders, PP. The piston rods of the air cylinders have a certain amount of vertical play in the pistons, so that the switches have a quick break. The switches are mechanically interlocked, as shown at Q, in Fig. 2. In addition, there is a compressed air interlock, which will be described.



Double-drum, single-reduction, 12,000-pound-pull electric hoist with compressed air control. Hoists of this type have been built for several Canadian mines.

In Fig. 3 is shown the controller for the rheostat and the primary switches. Lever B, which is connected by rods and shaft to the hand lever on the operator's platform, moves lever D through 2 to 1 gears. Levers D and E are connected to the floating gear which operates the rheostat valve, C. Cam F actuates the primary switch closing valves, G. Plungers H lock cam F, so that but one primary switch can be closed at a time.

In order that the primary switches may not be opened under full-load current, they are not operated directly by the controller but from the rheostat. The primary switch exhaust valves are opened by cams on a rod attached to the counterweight. They open when the weight is in its lowest position, that is, when the rotor circuit is open and the only current flowing in the primary circuit is the magnetizing current. The opening of any of the primary switch exhaust valves allows air to escape from the corresponding air cylinder—P, Fig. 2—and also from one of the interlock plungers, H, shown in Fig. 3. This arrangement insures, first, that the primary switches are only required to break the magnetizing current, and, second, that the motor can be reversed only when the maximum resistance is in the rotor circuit, that is, when the circuit is open.

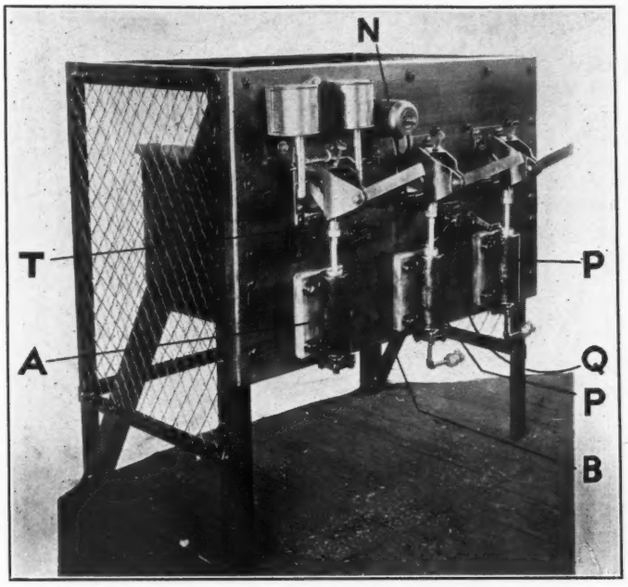


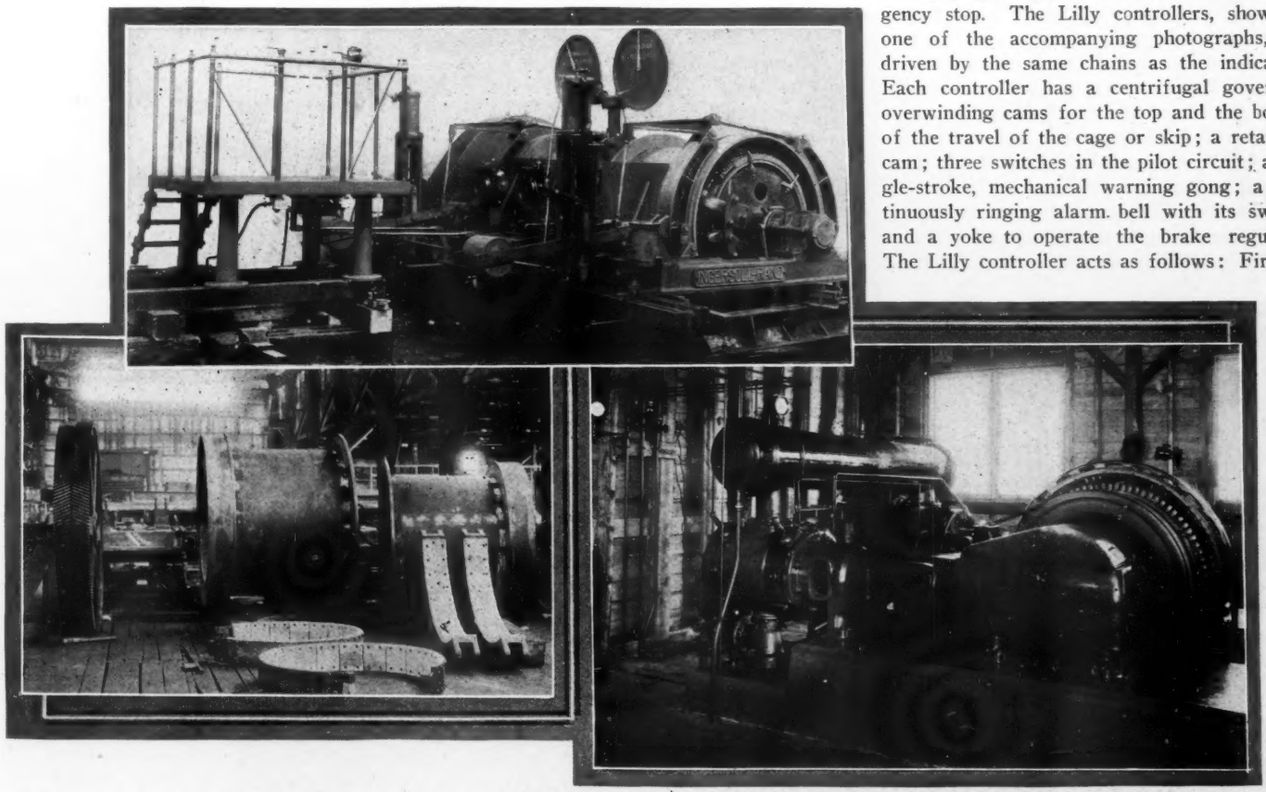
Fig. 2—Switchboard of the new type mine hoist.

Provision is made for automatically stopping the hoist by shutting off the motor and applying both brakes under the following conditions: Over-winding at top or bottom of either shaft; overspeeding; failure to retard properly when approaching the landing at top or bottom of either shaft; overloading the motor; failure of electric power; and failure of compressed air supply.

The stopping of the hoist is controlled through the circuit breaker and associate elements, as shown in Fig. 2. No-voltage coil N is connected in a pilot circuit, which may be opened by various means to be described. The opening of the pilot circuit allows the armature of coil N to fall, which trips the circuit breaker. The circuit breaker, in opening, trips the air trigger valve T, which in turn opens a large emergency release valve that lets air out of the brake cylinders and the rheostat cylinder. This sets both brakes and opens the rotor circuit and the primary switch. The motor is thus shut off completely by the opening of the circuit breakers, the primary switches, and the rotor circuit. At the same time both brakes are set by their weights. Failure of electric power would allow the no-voltage coil N to trip the circuit breaker and stop the hoist, as just described. Overloading the motor will cause the overload coils in Fig. 2 to trip the circuit breaker, and this will also stop the hoist in the manner outlined.

Failure of the air supply is provided against by the auxiliary air compressor, which has an automatic starter on the motor and will start if the air pressure falls to 70 pounds, let us say. In the event of any accident—such as the breakage of a pipe fitting in the air system which would exhaust all air from the system—the hoist would be stopped, as follows: the counterweight on the rheostat would open the rotor circuit and, at the same time, open the primary switch exhaust valves. These, in turn, would open the primary switches. Both air brakes would also be set by their weights. When the hoist has been stopped by the opening of the circuit breaker, the engineer resets the circuit breaker by putting the motor-control lever in "neutral" and the two brake levers in the "on" position. This prevents a runaway when restarting the hoist after an air emergency stop.

We will now take up the various means for opening the pilot circuit to make an emergency stop. The Lilly controllers, shown in one of the accompanying photographs, are driven by the same chains as the indicators. Each controller has a centrifugal governor; overwinding cams for the top and the bottom of the travel of the cage or skip; a retarding cam; three switches in the pilot circuit; a single-stroke, mechanical warning gong; a continuously ringing alarm bell with its switch; and a yoke to operate the brake regulator. The Lilly controller acts as follows: First, in



Top—Shop view of one of the hoists with operator's platform temporarily placed before it. The counterweights and the pneumatic cylinders of the clutch mechanisms are mounted on the front of the hoist foundation. Left—Gear drums, brake parts, and clutch bands before assembling. Right—An 18 and 11x14-inch Class PRE-2 compressor which furnishes air for the driving of drills as well as for the control of the hoist at Schumacher.

case of overspeeding, the governor opens a switch in the pilot circuit and stops the hoist. Second, when overwinding, one or other of the two cams opens a switch in the pilot circuit and stops the hoist. Third, in retarding, the single-stroke warning gong rings when the engineer should start to retard. If he does not then begin to retard, and keep on retarding at the predetermined rate, the continuously ringing alarm bell sounds. If the engineer does not heed that bell, the governor opens a switch in the pilot and stops the hoist. Fourth, in regulating, the hoist must not be stopped too quickly at high speed, or undue strain will be put on the gears, rope, etc. On the other hand, the brakes must be set quickly in case of overwinding. This is accomplished as follows: In the air pipe leading to each brake engine is a balanced piston valve, controlled by a cam on the Lilly controller. This valve is partly closed when the cage or skip is in the middle of its travel, and is opened by a cam as the cage or skip gradually approaches a landing.

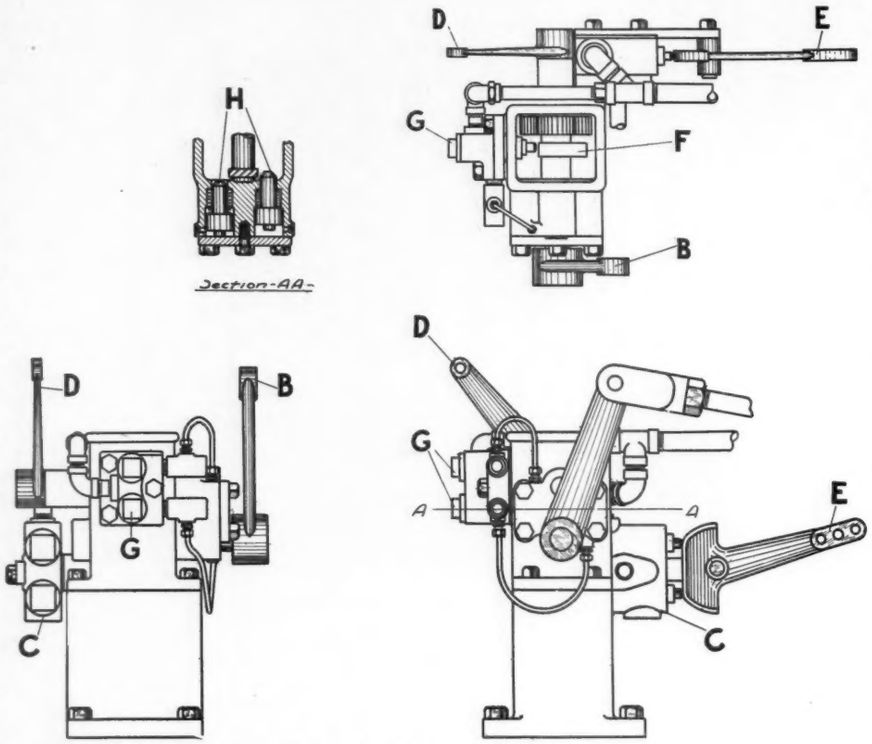


Fig. 3—Sketches of various parts of the controller for the rheostat and the primary switches.

Besides the aforementioned overwinding switches on the Lilly controllers, there is a track-limit switch in the head frame for each shaft. This provides against stretch of rope, gives a little closer adjustment of the point of emergency stop than is possible with the cam on the Lilly controller, and is an additional safeguard. It also provides a safety stop while the cams are being set. The track-limit switches are substantial drum-type switches in cast-iron boxes. They are opened by a bar, on the cage or skip, which strikes a fork on the switch. The switch remains open till the bar closes it again in backing out.

In addition to these eight switches for automatically opening the pilot circuit, there is an emergency switch on the operator's platform. This is a single-pole, enclosed knife switch. It is used to test the emergency stop, and also enables the operator to stop the hoist in case of failure of any of the mechanical devices, or should he become confused.

In the event of overwinding, it is necessary to close the circuit through the no-voltage coil before the hoist can be started again. For the sake of safety, it is desirable that this circuit should not be closed in such a way as to make it possible for the operator to render any of the safety devices inoperative by failure to open the switch again. It is also desirable that he should not be able to move the cage or skip any farther in the direction in which it is already overwound. This is accomplished in the following manner.

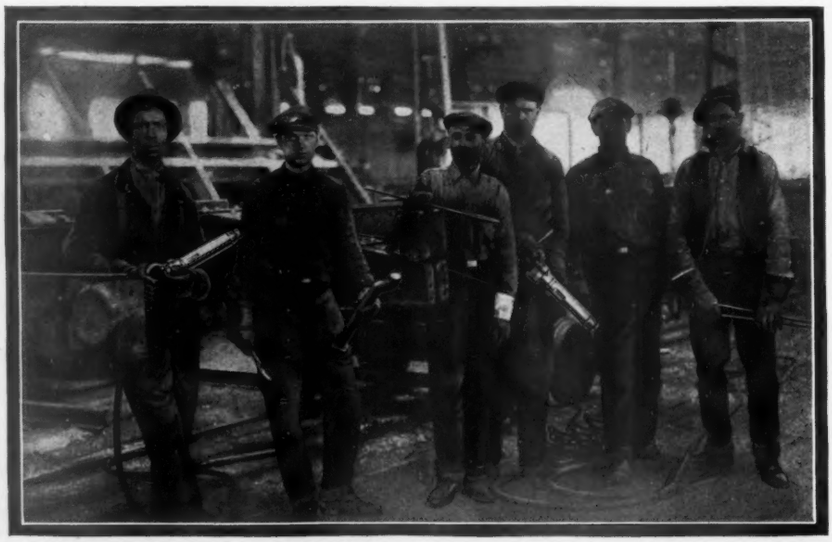
On the operator's platform are two reverse protection valves, each of which is interlocked with a back-out switch. Each control lever is marked "run" and "back." When the lever is turned to "back," it closes the switch and closes the valve. The closing of the switch closes a shunt circuit through the no-voltage coil, which allows the hoist to be started in the right direction. The closing of the valve shuts off the air line to one of the primary switches, which prevents the hoist from being started in the wrong direction. If the engineer forgets to turn the lever to "run," after backing out, he cannot hoist again until he has done so.

It would appear that every operating contingency has been provided for. The engineer might even fall in a faint while the hoist is running full speed, and it would be brought to a stop gradually and properly before reaching the end of its travel.

CHAMPIONS ALL OF THEM

FRIENDLY rivalry among riveters is still happily much in evidence in various departments of our industrial life. The following interesting item is taken from an issue of *The Ralston Hopper*—the house organ of The Ralston Steel Car Company. It shows what thoroughly efficient tools in the hands of skilful workmen make possible.

The accompanying picture is that of two gangs who drove 4,080 rivets in 10 hours on a Southern Pacific Railroad job in connection with 34 tight-bottom, gondola cars. Of this total, 136 were ⅞-inch, 1,020 were ¾-inch, and 2,924 were ⅝-inch rivets. The gangs were equipped with the new Ingersoll-Rand No. 6 riveting hammer; and the men were very much pleased with the tool. As they expressed it: "If the other gangs want to keep up with us they will have to go some."



All these men are proud of what they were able to accomplish with the new riveting hammer.

Reading from left to right, the men are: E. L. Williams, riveter; John Gallick, bucker; Mose Bine, heater; Joseph Dymek, riveter; Frank Kusskowsky, bucker; and B. A. Hodapp, heater. Mr. Fox, the works manager, is justly proud of the showing and of the gangs.

SPRAYED-METAL COATINGS TO BAR INSECTS

IN California and other places where the climate is warm, wood is attacked by white ants, while lead-cable sheathing suffers from the depredations of the cable borer or "short-circuit beetle." The latter cuts its way through lead with ease if it can find a suitable fulcrum from which to work. A possible method of keeping the pests out would be to cover the cable at points likely to be damaged with a hard coating of some sort that they could not bore through.

It is suggested that a suitable metal sprayed over the exposed surfaces of the lead may solve the problem. This is entirely feasible, as apparatus have been devised that spray metals by means of electricity and compressed air.

USING KIESELGUHR AS A BUILDING MATERIAL

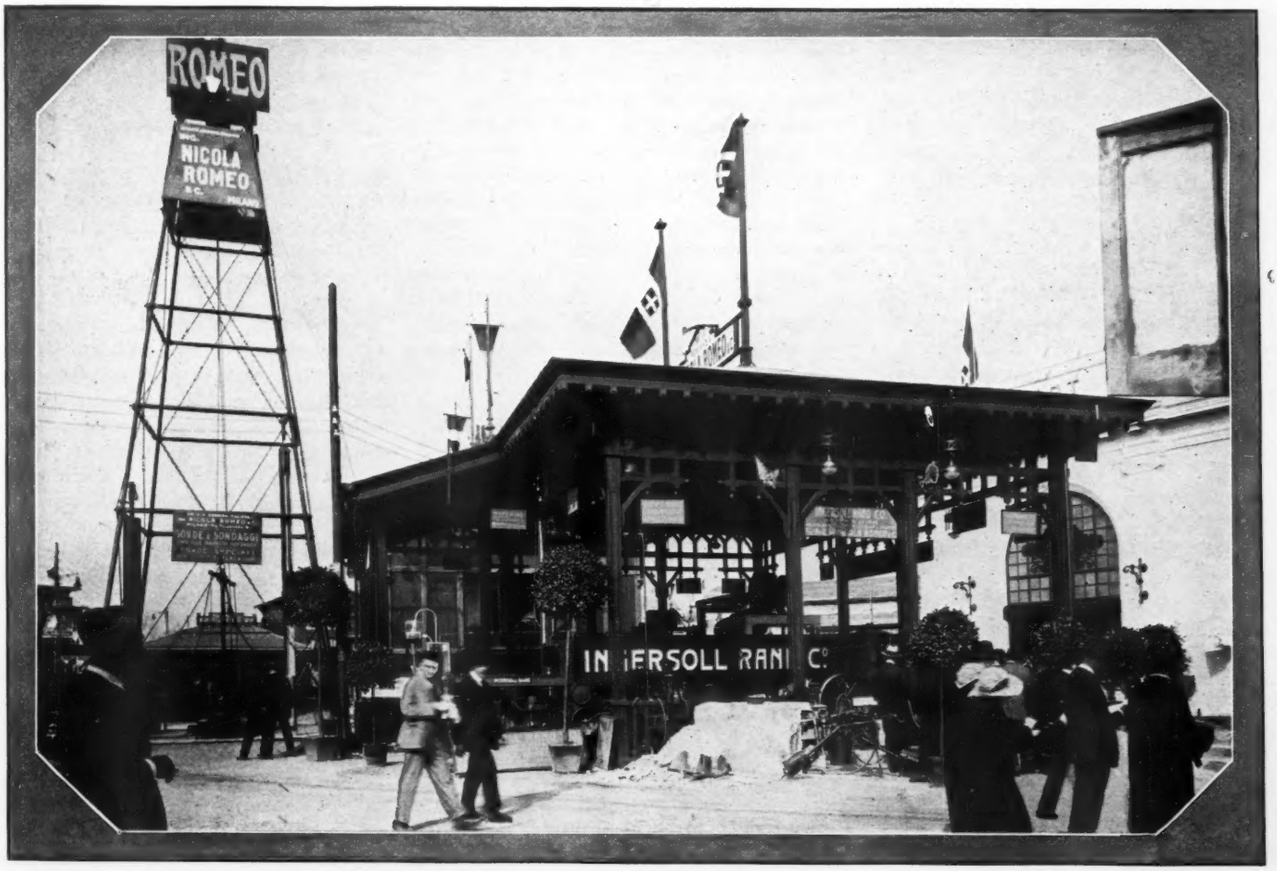
A COMPANY has recently been formed in Sweden for the exploitation, as a building material, of the large deposits of kieselguhr in the polder of the former lake of Jallasjo. Some years ago the state geologist found that the bed of the diked lake consisted of a compact and homogeneous mass of kieselguhr, which differs from all others in that it contains a natural admixture of about 20 per cent. bituminous products. These form an excellent binder and make it possible to press the raw material into solid sheets for the covering of walls, ceilings, and floors. As no like raw substance has been found elsewhere in the world the deposits are very valuable, especially as the supply is enormous. It is estimated to amount to about 1,050,000 cubic yards, lying in a homogeneous stratum 16½ feet thick. The quantity is not only sufficient to furnish the whole of Scandinavia with building material for generations to come but there is enough to permit exporting it on a large scale.

Kieselguhr has long been known to scientists as an excellent heat-insulating material. Unfortunately, it has heretofore not been practical as a building material, owing to the difficulty experienced in binding the dustlike powder without spoiling its characteristic qualities and making the final product too expensive. The present owner of the deposits, after years of experimenting, has succeeded in developing a mechanical method for the quantity production of sheets or plates, and he has also devised a simple and inexpensive process for impregnating them so that they will be completely impervious to moisture. These methods, together with the deposits, have been taken over by a Swedish company. The preliminary plans are to produce 1,075,000 square feet of insulating plates annually; but this output is to be increased as soon as practicable.

Tests now being conducted in some of the big Pittsburgh mills with a new process for making stainless steel and iron are being watched with great interest by steel men. Stainless steel is not altogether a new product; but it has heretofore been used only in the manufacture of cutlery and other small articles because of the high cost of production. The new method, it is claimed, will so reduce the cost that it will be possible to utilize stainless steel for an unlimited number of purposes.

Portland cement, so *Concrete Highway Magazine* tells us, is now 100 years old. It was invented in 1824 by a British mason, who called it "Portland cement" because of its resemblance, when hardened, to an English building stone quarried on the Isle of Portland. The first American plants for its manufacture were established 48 years later. Today the United States produces more Portland cement than all the rest of the world combined.

To a generation that thinks of electric dynamos of 70,000 and 80,000 H. P. as great machines, one of 125 H. P. will seem a puny thing. And yet it was a generator of that size that served New York City when the first Edison electric power plant was placed in operation late in 1882. So large was this piece of machinery then considered that the only fitting name that could be found for it was "Jumbo."



Air-driven tools and machinery enjoyed prominence at the Milan Industrial Fair in Italy. The picture reproduced above shows the Romeo-Ingersoll-Rand stand. Like everywhere else, enterprising Italian engineers, builders, and plant operators are turning more and more to the use of air-driven appliances to speed up work and to lighten labor.

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EDITORIALS

DIRECTIONAL WIRELESS

THE wonders of communication by radio, amazing as they are, are relatively speaking as yet only in their infancy. The wise men of the art have promised tremendous developments in the near future; and recently GUGLIELMO MARCONI has made very definite announcements regarding the commercial possibilities of his wireless-beam system for the distant transmission of directed radio waves.

It is still fresh in the minds of most of us how the voice was first transmitted from Arlington, Va., and rendered audible at the Eiffel Tower, in Paris, nine years ago when atmospheric conditions happened to be exceptionally favorable. It will be recalled that, generally speaking, radio waves radiate in all directions from the sending source; and to give these waves long range it is necessary to employ generating sets of considerable power. In other words, to reach a definite receiving station, an excess of energy is initially required to cover the transmission losses incident to scattering this energy in all directions.

SENATOR MARCONI and a fellow worker, Mr. C. S. FRANKLIN, have devised reflectors or grids composed of wires so arranged in relation to the antenna that the arc of these wires acts upon the wireless waves much after the manner of a parabolic mirror in reflecting and concentrating the beams of a source of light. Curiously, short waves have been found especially suited for use in connection with this system of directional radio because these waves are not subject to anything like the same atmospheric handicaps to which the longer waves are responsive.

In a recent issue of *The Engineer*, of London, was reviewed a paper read a short while previously by Senator MARCONI, and tests made between the Senator's yacht, the *Elettra*, and the wireless station at Poldhu showed not only that a number of excepted theories about radio were erroneous but that 100-meter waves have certain advantages which had not hitherto been suspected. For instance, the day ranges proved to be reliable and not inconsiderable, while the night ranges were found to be much greater than anyone had anticipated. Intervening land and even large portions of continents did not present any serious obstacle to the propagation of these waves.

According to *The Engineer*: "During night time, even when receiving at St. Vincent, which is 2,330 nautical miles from Poldhu and well within the tropics, the strength of the received signals was so great that the atmospherics did not interfere in any way with the reception of signals or messages from Poldhu, where the input to the valves amounted only to twelve kilowatts—the radiation from the aerial being approximately nine kilowatts. The parabolic reflector concentrated the energy towards Cape Verde and gave in that direction a field strength which would have required a radiation of approximately 120 kilowatts from the aerial without a reflector."

What this advance means is that it will be possible to cover long distances with far less powerful and, therefore, less expensive sending equipment than has been needful heretofore. This will not only cheapen radio communication but add tremendously to its effective utilization day or night, summer or winter, under all conditions.

SAHARA NOT REALLY DRY

THE dryness of the Desert of Sahara is only superficial. There is ample warrant for the belief that under vast areas of those arid sands lies an abundance of fresh water. Not only that, but it has been proved repeatedly that those subterranean bodies of water are filled with forms of aquatic life that are identical with those that flourish in the Congo, the Niger, the Senegal, and the Nile Rivers as well as in lakes Chad and Tanganyika.

Ever since the French sank the first of their Artesian wells in Southern Algeria in 1856, water coming to the surface from depths of from 200 to 300 feet have brought with them shellfish and various other species of fish that are the same as those found in above-ground bodies of water in widespread sections of Northern Africa. These creatures are not blind or peculiarly colored, as is commonly the case with fish found in caves where they have been isolated and shut off from the light of day. Therefore, the subterranean fish of the Sahara must have access to the rivers and the lakes mentioned—indicating that they do not spend all their time underground. Clearly, then, there must be linking channels between the surface and the subsurface waters.

Tradition among the Arabs has it that there was plenty of water in the Sahara in the seventh century, and that it was not until six hundred years later that the region became what it is today. The geological change which brought about the subsidence of the land and the disappearance of flowing rivers was seemingly not radical enough to completely prevent the erstwhile surface waterways from following passages open to them hundreds of feet beneath the sandy wastes. In no other way can conditions as they have been disclosed by the sinking of Artesian wells be logically explained. Therefore, the modern engineer, with up-to-date facilities, should be able to tap virtually inexhaustible reservoirs of subterranean waters so that more and more of the really fertile soil of the Sahara can be made fruitful. Probably the air lift may be found best suited for raising these living waters from the depths.

Perhaps it is not merely a dream that in this fashion the grimness of the desert may be dissipated and the burning sands of today become cloaked with a wealth of verdure and be made the means of supporting hundreds of thousands, yes, millions of people.

NEED OF VARIED READING

THE foregoing title appeared recently in connection with an editorial in *Commerce Reports*, and the aptness of the topic and the manner of its presentation have appealed to us strongly.

COMPRESSED AIR MAGAZINE is published to benefit many men of many minds and also to widen the helpful contacts of every one of its readers. Therefore, what the Government publication has to say seems to us to be peculiarly pertinent. So let us quote: "Contrary to a well-worn maxim, there is a distinct peril in sticking too closely to one's business. This is particularly true with respect to the reading of economic news for purposes of information.

"A widely informed man cultivates a catholicity of interest. A steel man may find that a report designed for the lumber industry contains news and suggestions of great value to him. He who sells in China may find that a cable report from Johannesburg can stimulate a trend of thought that would increase his business in Shanghai.

"To confine the reading of a commercial publication to a particular column is a narrow practice that must inevitably operate to the detriment of the reader."

CRUDE RUBBER CULTURE IN THE UNITED STATES

EVERY pound of crude rubber used in the United States—and we annually import about 300,000 tons—is grown on alien soil, largely in British and Dutch dependencies.

Henry FORD, who buys more rubber tires than any other manufacturer of automobiles, and Harvey FIRESTONE, who makes most of the Ford tires, do not like to be dependent upon foreign sources for this raw product. They are therefore starting a rubber plantation in Florida. True, it is the wildest kind of a venture, as no rubber trees have ever been successfully cultivated outside of the tropics. But FORD and FIRESTONE are going to find out on a large scale if it can be done. Perhaps it can. There was a time when nobody believed that Para rubber could be raised away from its natural environment—Brazil; but the Far East now

furnishes nine-tenths of the supply, grown from Brazilian seed.

But there is a species of crude rubber obtainable in the United States. In the arid regions of Nevada, California, Wyoming, Oregon and Montana is found a certain shrub known as "rabbit brush" or, as the botanists would have it, *Chrysothamnus nauseosus.* This brush yields a variety of rubber which, though not as good as Para—the market standard, is said to be better than other grades of so-called wild rubber.

Reports claim that 150,000 tons of this crude await anyone who will go after it, and that the acreage can be vastly increased by cultivation. The question is, why is this domestic source of rubber neglected? Is it because it is inferior to the standard in use, or because it is easier to import than to "go get it?"

HUNDREDTH ANNIVERSARY OF FRANKLIN INSTITUTE

IN 1824, the Governor of Pennsylvania signed an act incorporating The Franklin Institute of Pennsylvania for the Promotion of the Mechanic Arts; and the centennial of the Institute is to be celebrated on September 17-19 of the present year at its home in Philadelphia.

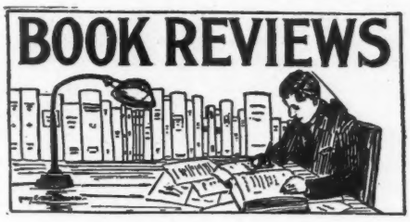
This institution has attended strictly to business throughout all those decades, and has achieved a great work in collecting, in investigating, and in disseminating accurate advance information relating to matters mechanical and scientific—doing it all without display and without the extravagant expenditures usually involved. It has much to be proud of; and few centennials have been so completely commemorative of valuable accomplishment. We may hope for and confidently predict another hundred years of uniformly successful activity.

INCREASING USE OF SAND BLAST

THE sand blast seems to be continually finding new and wider fields of employment. It began with the roughest kind of work—cleaning castings in the foundry, and then it naturally found other work in the metal industries for cleaning surfaces to be lacquered or electroplated. Now it is finding its way into the power house.

At the annual convention of the American Waterworks Association, Mr. Leonard A. Day told of the effective application of the sand blast at the St. Louis pumping station, where steam turbines are used to drive centrifugal pumps. It was found that the efficiency of the units had fallen 25 per cent. from the initial and guaranteed figures; and investigation revealed that the first five rows of turbine blades were almost completely closed with sediment.

After the replacement of a few rows, the entire blading surface was given a thorough sand blasting. This effectually removed all the scale; and, upon the resumption of service, the original steam consumption guarantees were equaled. The sand blasting of boiler tubes is an established thing, removing soot as well as scale and leaving the metal surface clean; but the sand blasting of turbine blades seems to be an entirely new practice.



RAILWAY RATES AND COST OF SERVICE, by Owen Ely, Ph.M., Boyer Fellow in Transportation, 1911-13, University of Michigan. A book of 148 pages, published by Houghton Mifflin Company, Boston and New York City. Price, $2.00.

RATE making and railroad revenue are intimately related; but in America, at least, the procedure employed in establishing freight rates in particular can hardly be called a matter of logical analysis. Indeed, many of the rates in force have been arrived at as a consequence of expediency or practice, and have in no wise been established in agreement with any so-called "fixed standards." This has made for confusion and for much protesting.

The author says: "The rate structure is of greater importance in our social scheme than is generally realized. It controls to a considerable extent the localization of industry and the distribution of population. It has much to do with the economy of large-scale production, which to a considerable extent means large-scale marketing. These facts are realized by most students of transportation, and sooner or later the problem must receive the public attention which it deserves." In short, this subject is intimately associated with the present and the future status of our railroads and, therefore, has to do with one of America's most pressing and complex problems. With good reason, the volume in question is described as a lucid, a timely, and an impartial analysis of a very important problem.

MAKERS OF SCIENCE, by Ivor B. Hart. An illustrated volume of 320 pages, printed by the Oxford University Press, American Branch, New York City. Price, $2.00.

STRICTLY speaking, the purpose of this work is to focus popular attention especially upon those men of science from the days of Aristotle onward that have been conspicuous in mathematics, physics, and astronomy. In this way, the author has sought to mark some of the milestones of human progress in the field of science and to so present a series of these developments that the present-day student might have at his command or his education a background by which to appraise our modern status in these departments of research and knowledge.

Dr. Charles Singer, in the introduction, says: "In all these countries and at all these periods the organic apparatus by which new knowledge has been created has been the work of a mere handful. Surely the contemplation of the conditions under which these men worked and lived, the examination of their training and mental history, of their environment and manner of development, must be of value—even in the practical everyday sense—to those who would follow in their footsteps." The book is well written and entertaining, as well as instructive.

COMPRESSED AIR DATA, edited by W. L. Saunders. A copiously illustrated work of 290 pages, published by Compressed Air Magazine, Bowling Green Building, New York City. Price, $3.00.

THIS valuable handbook of pneumatic engineering, which now appears in its second edition, has already established for itself a place among laymen as well as among technicists interested in compressed air and that motive medium's wide and steadily growing field of usefulness. The work contains a fund of approved formulae and general data. Complicated mathematics have been purposely omitted or simplified so that the book would make a special appeal to the practical man as well as to the more technical engineer.

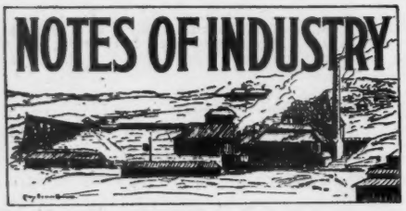
The original edition was brought out in 1919, but progress in pneumatic engineering has been so marked since that the publishers very properly decided to remodel the book and to bring it thoroughly up to date. This has been accomplished after considerable research and labor; and in its present form *Compressed Air Data* should be even more useful and worth while than it has been in the past.

THE STORY OF BAKELITE, by John Kimberly Mumford. A work of 80 pages appropriately illustrated. Published by Robert L. Stillson Company, New York City. Price, $1.00.

TO be exact, this rather fascinating brochure is a biographical sketch of Dr. L. H. Baekeland and of what that eminent chemist has done in his particular realm of industrial usefulness. Bakelite is a synthetic product and the climax of years of research in which Doctor Baekeland was one among many using the same elemental materials. In its earlier applications, bakelite, a resinous product, was employed mainly as an electrical insulator, but it has proved valuable in many other directions since. As time goes on this unique material will probably be adapted to scores of other services; and many of us use it today unaware of the fact that the handy article is fashioned of this substance. As the author expresses it: "Wherever wheels whirr, wherever women preen themselves in the glitter of electric lights, wherever a ship plows the sea or an airplane floats in the blue—wherever people are living, in the Twentieth Century sense of the word, there Bakelite will be found rendering its enduring service."

Origin, Development, Results of Elesco is the subject of a booklet lately published by The Superheater Company of New York and Chicago, makers of Elesco superheaters. It gives in brief form the history of the company and the growth of its operations in connection with the manufacture of superheaters for every type of steam boiler employed in locomotive, marine, and stationary services. A copy of the book will be sent to anyone mentioning this Magazine.

Year Book American Engineering Standards Committee, 1924. The committee is the national clearing house for industrial standardization—a federation of the principal national organizations and governmental departments that are active in such work. Its year book should, therefore, make a very wide appeal.



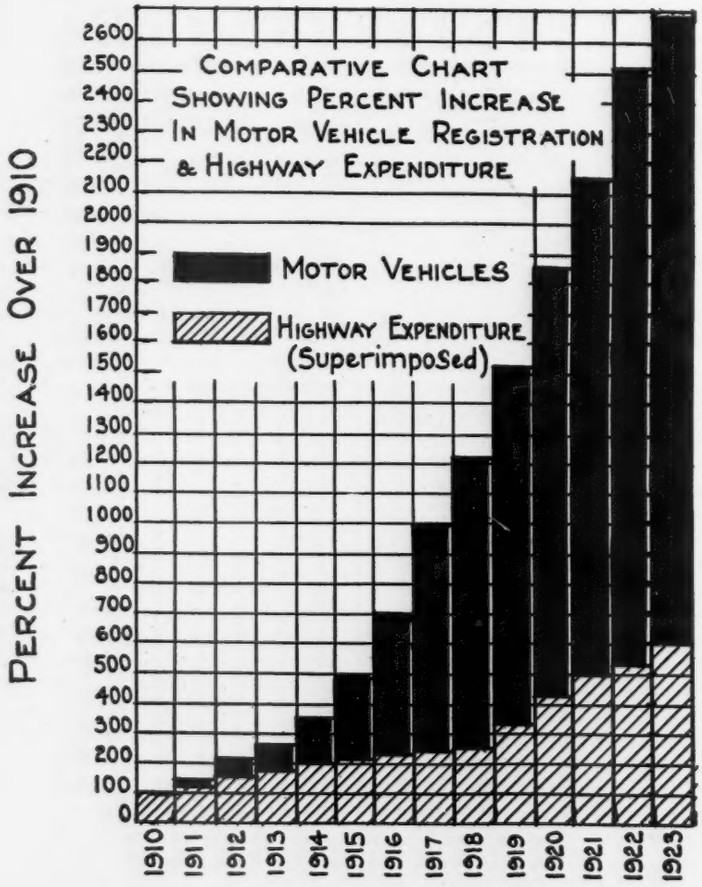
A well, drilled by the Utah Oil Refining Company in central Utah, has developed a flow of gas possessing characteristics different from those usually displayed. The gas is colorless, non-inflammable and odorless, except for traces of hydrogen sulphide. A representative of the United States Bureau of Mines was sent, upon request, to test the gas for helium, but an analysis showed that there was none of that element present. It was, however, disclosed that the gas is almost pure carbonic acid.

Bills have been introduced by the Canadian government for the extension of the existing National Railways. It is proposed to spend about $26,000,000 on these projects, which are to include the building of 26 branch lines or 946 miles of trackage.

The metric system of measurement became official in Japan on July 1 of this year.

The present quays of Rio de Janeiro are so inadequate that 40 per cent. of the craft calling at that port cannot dock but must anchor and discharge in the open bay. To properly accommodate the majority of these vessels, as well as to encourage ocean-going shipping, the wharves are to be extended, and contracts for this work have been signed. It is estimated that 3,400,000 cubic yards of earth will have to be dredged and that 4,708,000 cubic yards will have to be reclaimed. In addition, a breakwater is to be built, which is to contain 3,300 cubic yards of material.

Manufacturers in every American industry will be interested in the Exposition of Inventions to be held in the Engineering Societies Building, New York City, from December 8 to 13, inclusive. A feature of the exposition will be exhibits from leading industries, showing developments of various machines, utilities, processing methods, etc. Arrangements for the display of working models or actual devices can be arranged through a Committee of The American Institute, 47 West 34th Street, New York City.



Courtesy, Concrete Highway Magazine.

A graphic story with a moral. Expenditures on our highways have fallen far behind our investments in motor vehicles, and yet the effective use of these power-driven conveyances is dependent upon proper roadways. The figures show that our motor-vehicle registration has increased more than 2,500 per cent. in the course of the past twelve years, and yet disbursements for our highways have increased in the same interval only about 500 per cent.

In view of the prospects for the export of dairy and pork products, the South African Colony of Kenya is to erect a cold-storage plant at Mombasa.

There has recently been put on the market a so-called telemagnifier, a kind of indoor field glass. It is of the prism type, for one eye only, and by means of a long, adjustable, focusing range is suitable for distances of from 30 inches to 30 feet, and for magnifications of from 6 to 9 diameters, depending on the distance. The instrument is small and compact, can be easily used with one hand, and carried in the pocket.

We are told that the 1,000,000 motor trucks in service in the United States today haul annually a matter of 1,430,000,000 tons of freight. Of this amount 134,400,000 tons represent farm products.

A triple escalator, capable of carrying more than 400 passengers a minute, has recently been put in service at the Bank Station of the Central London Railway. The middle stairway is reversible—operating equally well in either direction to accommodate the diurnal exigencies of traffic. All three of the escalators have emergency circuit breakers so that the moving stairways can be instantly stopped.

The automobile club of Brazil intends to hold its third road congress on October 12 of this year, and plans to reserve that date for an annual road congress and automobile show.

As typical of the growing demand for electric current in France as elsewhere, the Societe Havraise d'Energie Electrique—which supplies the City of Havre and surroundings with power—reports that at the close of 1923 it had 25,464 consumers on its lines as against 21,376 at the end of 1922, a gain of 19 per cent.

The French possessions in tropical Africa while but little known are potentially important, covering an area nearly as large as that of the United States, or 2,970,300 square miles. The country is rich in mineral resources, which include gold, iron, tin, copper, aluminum, lead, chromium, salt, and phosphates. However, the exploitation of the deposits is still in its infancy.

In some electrotype foundries a jet of compressed air is employed to agitate the plating solutions so as to prevent the chemicals from precipitating and crystallizing out of the solutions.

The Calcutta School of Tropical Medicine, so we learn, has developed a system of house cooling by which a supply of cold air, previously passed over refrigerating coils, is forced into the rooms. The walls of the rooms are insulated with cork; and it is said that by this method the temperature indoors can be maintained at from 20 to 30 degrees below that prevailing outside. The new system has been used experimentally for two years and has proved entirely successful.

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